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JULY 1998

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# Electronics Australia

with PROFESSIONAL ELECTRONICS & ETI

July 1998

Volume 60, No. 7

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### On the cover

Sony's DVP-S715 is a true 'second generation' DVD player, as Louis Challis found when he reviewed it for this month's issue (see page

10). Its performance as a CD player also proved to be quite outstanding. Graham Cattley describes our new Bikecom project starting on page 42. (Photos by Phil Aynsley, Ben Granger)



### Courses in electronics



20

Want to learn more about electronics, and perhaps make it a career? Here are some of the courses available.

### Cheap, but fast too...



7

Kodak's new video camera for PCs has a USB interface, so it's fast!

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Yes, it can be done — if you're prepared to shop around, and assemble one from bits and pieces...

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# Letters to the Editor

## Boards by inkjet?

Wouldn't it be good if someone could adapt an inkjet printer mechanism to print resist-type ink (if there is such a thing) directly from a CAD program, onto an unetched PCB? That would be great for one-offs or small production runs.

There's the seed. All it needs now is someone with a bit of enterprise...

Graham Pratt (via e-mail).

## Pseudoscience

Congratulations on your article in the January issue about the prevalence of pseudoscience in the health industry, and useless electronic devices. Hopefully this will alert some people to the dangers to their health which these devices can cause.

But there are plenty of other people trying to use electronics in other areas which, while not as dangerous, have just as little scientific and technical basis as those you wrote about.

I have just received a catalog of items which can be bought by phone or mail. Among them is one advertised as 'Environmentally safe pest control'. This works, it is claimed, by simply plugging it into a power point, when it will send a low-frequency pulse through your electrical wiring system. This changes the existing electromagnetic field, creating an intolerable environment for unwanted intruders. It is claimed to be 'absolutely safe for humans and pets other than rodents'. At \$79 this would appear to be in the same class as those you investigated.

Then there are the claims we hear, from time to time, that someone has produced a device which produces more energy than it takes to run it. Despite what Peter Phillips wrote in Information Centre in the same issue, conservation of energy is one of the most fundamental laws in science, and has a vast amount of evidence, accumulated over hundreds of years, to support it. These devices which are claimed to produce energy mostly involve pulse circuits of some kind. Measuring accurately the energy involved in these requires quite complicated devices, and the usual analog or digital meter is likely to give very misleading results.

Perhaps EA could start a new column,

restricted to claims of this sort, so that electronics experts could try slaying some of these pseudoscientific dragons for which people are paying, with no results to show at the end of it.

Dr Ken Smith, University of Queensland.

## Safety cutout safety

Just a quick note to suggest that Steve Carroll's Fuel Pump Safety Cutout circuit (April 98 Circuit & Design Ideas) perhaps should have carried a warning about the risk of engine failure in the event of a broken fan belt. It could be argued that the effect is no worse than if the car ran out of petrol, and is possibly a protective feature, since it prevents the engine being run with no alternator/water pump drive, but I suspect that the authorities would take a dimmer view.

Most OEM fuel-injected vehicles have an electric fuel pump cutout that detects either air-flow in the intake path, or the presence of points/timing pulses from the distributor/ignition circuit. These ones are safer, since a belt failure does not cause unexpected loss of engine power.

Andrew Taylor, B.E. (by e-mail)

## Living treasure

After reading your editorial regarding living treasures in the February issue, I felt compelled to respond in regard to my dear friend and mentor, Neville Thiele. There are many things in my life that I am extremely grateful for, one of which was meeting Neville Thiele PB (pre-beard!) back in 1968. This was soon after my wife Jan and I had formed a new business — Audiosound Electronic Services.

During a subsequent discussion with Neville about the aims of the business (developing high quality amplifiers and loudspeakers) he drew my attention to his now famous 1961 IREE (Aust.) paper and encouragingly suggested a method of measurement procedures which I could do, give him the results over the phone, and he would calculate the resulting parameters to give me the low-frequency alignments back over the phone. (This involved roughly four hours of manual number crunching and equation solving for each individual design — it was before calculators too!)

For me, in 1968, in a new business, this was truly incredible and an instant



# Editorial Viewpoint

indication of this remarkable man's engineering ability and technical generosity, coupled with a friendly humour to someone he hardly knew.

To ensure reliable results on my part, I soon purchased (on special!) a new digital voltmeter and frequency counter capable of resolving down to 5Hz, in 0.1Hz increments. Soon after, having given Neville some proud results of a speaker test, he rang me to let me know that the results indicated a leak in the box! I knew immediately here was someone very special — who, from just a set of numbers read out over the phone, could analyse the data and tell me of my cabinet-maker problems.

This was only the beginning, and now after some 30 years he is one of my closest friends. On reflection, I can say that there would not be a single product that our business (now Audiosound Laboratories) has produced over this time that does not reflect a considerable amount of his electronic design expertise. I'm only sorry that the de-industrialisation of this great country with the dropping of tariffs, supported by both major parties over the last 20 years, has prevented myself and other small manufacturers here from being able to put more of Mr Thiele's engineering expertise into practice.

He is well known for his incredible contribution to the electronics industry worldwide, with over 50 engineering papers, not only on loudspeakers, filters and cross-over networks, but also for radio and television. Further, his untiring work on standards, both here and overseas, are legendary.

There have been many excellent people in the industry over the years. But I would not hesitate in recommending him for a very high award, as I feel Neville Thiele stands head and shoulders above all.

**Ron Cooper (MAES), North Curl Curl NSW.**

*Comment: I'm delighted that you were able to second my vote, Ron. We had very few other responses, sad to say...*

Letters published in this column express the opinions of the correspondents concerned, and do not necessarily reflect the opinions or policies of the staff or publisher of Electronics Australia. We welcome contributions to this column, but reserve the right to edit letters which are very long or potentially defamatory.



## Why CAN'T we do it HERE, in Australia?

and even goading the equipment makers to produce an ever-accelerating flood of new and enhanced products, for both the consumer and industrial markets, while the equipment manufacturers are in turn pushing the chip makers to achieve ever-higher goals in terms of higher chip performance, lower cost or (usually) both...

The creative and economic energy generated by this symbiosis is so strong that you can't help but be impressed. Or avoid being struck by the obvious question: why in hell can't WE do the same thing over here? I don't mean the odd little boutique chip design effort, or semi-token exercise set up by a multinational largely to win a significant defence or other government contract; I mean a serious, real world, boots-and-all chip design and manufacturing industry, and the healthy electronics industry it would almost certainly feed.

Yes, yes, I've heard all the usual arguments as to why it can't be done. Especially the one about fab plants being far too expensive, in terms of capital and running costs. But exactly the same applies in Silicon Valley, and their answer was to come up with the so-called 'fabless model', where companies do all of the design, development, testing and marketing themselves, and simply subcontract out the fabrication and assembly operations to the highly competitive foundries and assemblers in Korea, China, Singapore or wherever. Not having your own fab is not a problem; in fact as many Silicon Valley firms will tell you, it's often a positive advantage.

What's the *real* reason why we don't seem to be able to get a solid, dynamic and viable chips-and-electronics manufacturing industry going in Australia? Is it lack of real commitment by a succession of short-sighted federal governments, resulting in an economic climate that is now essentially poisonous to high-tech manufacturing? Is it a serious shortage of venture capital, due to an absence of vision or creativity by banks and other big investors? Is it simply a dearth of real entrepreneurial spirit and manufacturing management capability? Are our entrepreneurs only good at asset stripping and investing in real estate? Perhaps it's all of these things, and more.

I'm blessed if I know the answers, but then I'm not a hot-shot economist or an entrepreneur — just a magazine editor, who's watched and listened enough to know that Australia has a serious problem in this area. Despite the fact that we have no shortage of very talented scientists, engineers, technicians and designers...

When I left school in 1957, Australia had a thriving electronics manufacturing industry. Why have we let most of it slip down the gurgler, my fellow Australians?

**Jim Rowe**

A few weeks ago, I was able to spend a busy week visiting various high-tech firms in Silicon Valley, as part of a contingent of Asian electronics magazine editors. It was the second such tour I've been lucky enough to make, and as before it was very rewarding to visit both new and long-established companies, learning not only of their latest achievements but also about their plans for the near-term future. Over the next few months I hope to bring you more articles passing on some of the same insights.

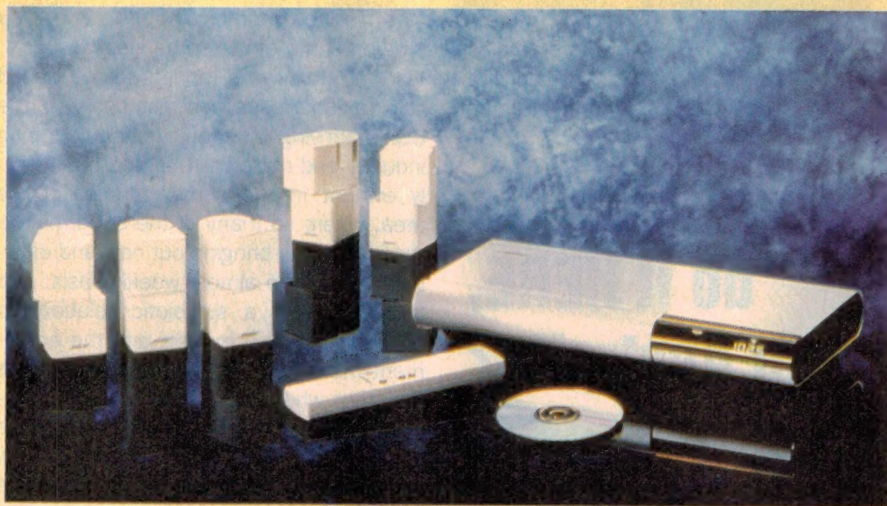
One of the things that struck me, though, as we visited firm after firm, was the enormous contrast between the USA's thriving electronics manufacturing industry and our own. This was particularly evident in the semiconductor device area, where so many of the US firms are roaring ahead, bringing out new and exciting chips on an almost weekly basis. And there's clearly a symbiotic relationship between the chip makers and the equipment manufacturers — regardless of the countries wherein the latter may be located. The new chips are making possible



# WHAT'S *new*

in the ever-changing world of electronics

## Home theatre system from Bose



Bose has released a range of three new integrated home theatre systems — the Lifestyle 8, Lifestyle 25 and Lifestyle 30

systems — which expand upon the company's well known Lifestyle music systems and use the same very compact satellite

speakers combined with a high-performance active subwoofer.

The Lifestyle 30 is the premium system in the range, and comes with five identically matched compact Jewel Cube array speakers (each only 114 x 57 x 83mm), a slim brushed aluminium Lifestyle music centre containing a compact six-CD changer plus AM/FM radio tuner, a radio frequency remote control and Acoustimass active subwoofer module with multiple power amplifier channels. Technologies incorporated in the system include VideoStage surround sound decoding and steering logic; Bose patented signal processing, active equalisation, extended bass response and two-zone expansion capability.

The Lifestyle 30 system retails for \$6750, with the smaller Lifestyle 25 and 8 systems retailing for \$5499 and \$2499 respectively. For more information circle **151** on the reader service card or contact Bose at 1 Sorrell Street, Parramatta 2150.

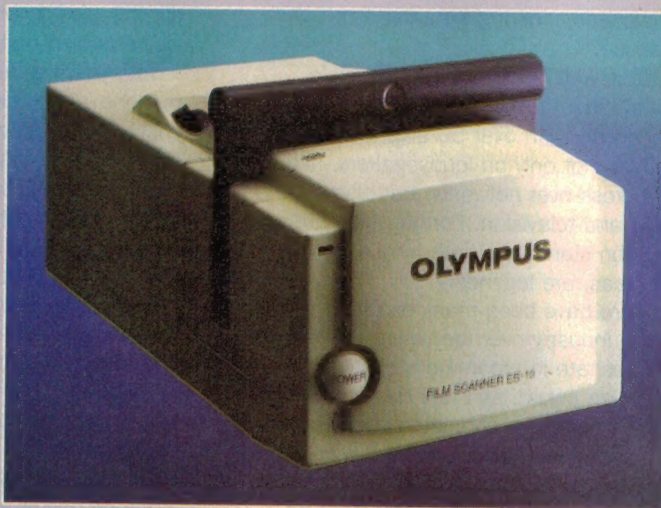
## Windows 35mm film scanner from Olympus

Olympus has expanded its digital imaging product range with a competitively priced 3.8-megapixel film scanner for 35mm & Advanced Photo System film. The new ES-10 film scanner features the advanced Olympus Super Latitude scanning system for high quality imaging, a single-pass CCD, and a single-point fluorescent light source, with variable resolutions up to 1600 x 2400 pixels (3.84 megapixel) for 35mm film.

Olympus says the Super Latitude scanning system boosts colour sensitivity for richer and more detailed scans, with the subtle gradations in colour tone normally found only in original film. It's claimed that this gives ES-10 scans a dynamic range equivalent to much more expensive 30-bit scanners.

Designed especially for SOHO users, the ES-10 is extremely easy to use. It connects to the parallel printer port of any Windows PC (including laptops), and has its own pass-through printer port, so the scanner and printer can share the same printer port. It comes with Olympus control software which allows users to preview an image to be scanned, crop out unwanted portions, adjust exposure and colour balance, and also acquire images into any software package that supports TWAIN. Also included is Olympus LAB-10 software for image retouching.

An A-10 Advanced Photo System Adapter converts the ES-10 film scanner for making a complete index scan of a roll of Advanced Photo System film. Users can also change the magnetically encoded information on each frame, label a photograph with preset titles, adjust the viewing format, as well as change the time and date stamp



— even if the camera used to create the image is not capable of all these advanced features.

The ES-10 weighs 1.3kg, measures 130 x 100 x 236mm (W x H x D) and sells for around \$859 including tax. The optional A-10 adaptor is \$299. For more information circle **147** on the reader service card or contact R. Gunz (Photographic), Locked Bag 690, Beaconsfield 2014.



## Digital videocamera for PCs offers USB speed

Kodak Australia has announced the company's second digital video camera that supports the high-speed Universal Serial Bus (USB) interfacing to a PC. The Kodak Digital Science DVC 323 captures both motion video and high-quality still pictures, and provides live video conferencing at the desktop or laptop.

The DVC323 employs Kodak proprietary hardware compression, delivering improved video quality and gives twice the video frame rate (30fps) achieved by the DVC300 — Kodak's original USB digital video offering. It supports the industry standard video-conferencing requirements of CIF (352 x 288) and QCIF (176 x 144) resolutions, and also offers 160 x 120 and 320 x 240 video modes. Uncompressed 24-bit 640 x 480 still images can be downloaded to the desktop in seconds.

The DVC 323 features a sleek 'phaser-like' design, measuring 51mm wide by 127mm deep and weighing less than 230 grams. It ships with everything people need to edit, cre-

ate and share their still images or motion video. The software supports Windows 95 OSR2 or later, and includes drivers for the beta versions of Windows 98 and Windows NT 5.0. (Updated versions of the drivers will be available from the Kodak web site)



PictureWorks Live is the key application for still and motion image capture, with Kodak's Digital Science Picture Easy 2.0 software providing a very easy way to perform basic still imaging and printing functions along with seamless connection to Kodak's on-line imaging services. Also provid-

ed are Microsoft's NetMeeting videoconferencing and Metacore's Power2Go, TWAIN-compliant acquire modules and drivers, and a Video for Windows device driver.

The DVC 323 Digital Video Camera is available now through a wide network including retailers, camera dealers, catalogues and traditional computer dealers, for around \$349. For more information circle 145 on the reader service card or call Kodak on 1800 674 831.

## Handheld PC includes wireless, IR comms

Intermec Technologies' new Norand PEN\*KEY 6110 hand-held mobile computer is designed for customers who want powerful PC performance and fast communications integrated in a compact unit. Weighing only 795g (28 ounces) with battery, the unit packs a highly integrated 99MHz AMD 486 processor, up to 32MB of RAM and PC card expansion for additional memory cards or hard disk drives. It also has a read-



able 320 x 240 pixel four-level grey scale LCD touch screen and comes pre-installed with Windows 95.

A feature of the system is a built-in wireless data modem which allows fast and effective communications between a field worker and their office, plus a standard IrDA infrared interface which simplifies communications with printers, network ports and other mobile PCs.

For more information, circle 149 on the reader service card or contact Intermec Technologies Corporation, PO Box 4280, Everett, WA 98203-9280 USA.

## Pro audio unit combines CDP & cassette player

The Marantz Professional PMD350 is a rack-mount unit which shoehorns a PMD502 cassette player and a PMD320 CD into a single 3RU case — which Marantz says was a tricky but worthwhile exercise. The CD player and cassette decks are fully independent, each with its own separate controls, outputs and monitoring.



Both sections have their own robust backlit control buttons which enable the operator to edit or cue one section while the other is in use. The cascade facility provides for continuous playback of CD and then cassette and, in an emergency, by using the combined output a simple disco facility can be simulated complete with pitch control.

The CD section features +/-12% pitch control, auto cue, fader staff, single track play and Digital Out. The cassette section has +/-15% pitch control, Dolby B-C HX Pro noise reduction, auto and manual record level, mic input, digital counter with memory and quick reverse with optical detection.

Retail price (including tax) of the PMD350 is \$1495. For more information circle 150 on the reader service card or contact distributor AR Audio Engineering, 558 Darling Street, Balmain 2041.



# WHAT'S *new* in the ever-changing world of electronics

## DVD player from Pioneer



An established leader in Laserdisc player technology, Pioneer has already introduced several DVD players to the US and Japanese markets, and is now one of the first to introduce DVD into the Australian market. Its entry level second generation DVD/CD/Video CD Player, the DV-505, comes with a price tag designed to encourage new buyers and a performance to rival any top-of-the-line machine.

Key innovations in the DV-505 are its video performance, achieved by a 10-bit video DAC. On normal DVD 8-bit/13.5MHz video data, luminance and chrominance colour image signals are prone to deterioration in the process of digital-to-analog conversion during playback. Pioneer avoids this by converting the data to 10-bit/27MHz, improving colour clarity and resolution to levels that are

claimed to be nearly indistinguishable from the original picture source.

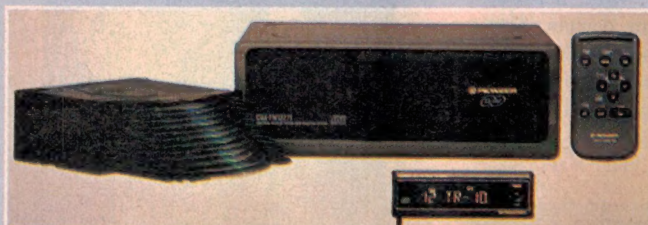
Another key video feature is a proprietary single lens, dual focus pickup assembly capable of playing both DVDs and CDs without the need for mechanical switching between lenses.

The DV-505 also achieves what is claimed as 'unprecedented sound quality' using a 96kHz/20-bit DAC. Pioneer's Hi-bit Conversion is also claimed to restore signals below 16-bit resolution, diminishing distortion and extending the dynamic range.

Other key digital audio features include Dolby Digital AC-3 and Virtual Dolby Surround decoding. A graphical user interface simplifies control of a wide range of operations through on-screen displays.

Recommended retail price of the Pioneer DV-505 is \$999. For more information circle 148 on the reader service card or contact Pioneer Electronics Australia, PO Box 295, Mordialloc 3195.

## Car CD changers use FM wireless link



Pioneer's new CDX-FM1227S and CDX-FM627S car CD changers have one notable feature which distinguishes them from other CD changers: they need no internal wiring to connect them to your existing car receiver, using FM modulation to make the changer audio audible merely by tuning the radio to a certain frequency. This makes them ideal for those who do not want to change their current receiver for one which handles CDs, or who lease cars or use company cars and therefore cannot change the configuration to enjoy the sound of CD music.

The changers are operated via hand-held IR remote con-

trol units, which give you the most frequently used functions at your fingertips.

The 12-disc CDX-FM1227S and the six-disc CDX-FM627S both provide Disc Title Memory to memorise and display up to 100 disc titles in 10 characters, plus Random Play which shuffles tracks and discs and plays them back in random order. They carry RRP's of \$799 and \$699 respectively and are available through selected Pioneer dealers.

For more information circle 142 on the reader service card or contact Pioneer Electronics Australia at 178-184 Boundary Road, Braeside 3195.

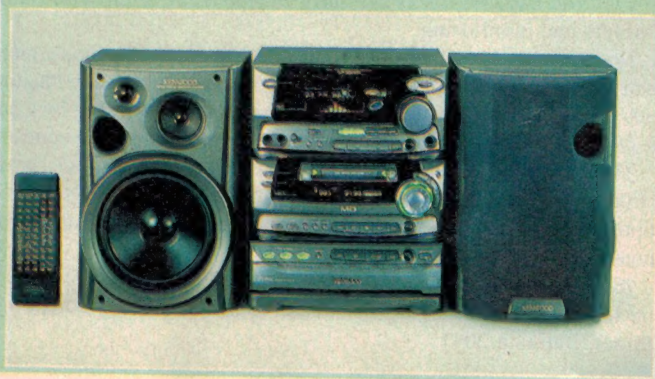
## Compact audio system features MD recorder

Kenwood has included a MiniDisc recorder into its latest compact audio system, the XD-980MD. Also featured is SRS (Sound Retrieval System) two-channel synthesised surround sound, 50W x 2 amplifier, a three-disc CD changer and 13-channel 'spectrum analyser'.

The XD-980MD's most outstanding feature, the MD (MiniDisc) Recorder, allows you to create personalised original Mini Discs from your favourite CDs, cassettes, and even LPs, with superior digital sound. Along with SRS tech-

nology the XD-980MD also provides an Extra Bass sound feature and three-way speaker system, plus a large multi-colour display which gives you a wide range of information at a glance — including the 13-channel spectrum analyser. There are also two microphone inputs, for karaoke.

The XD-980MD carries an RRP of \$1499, and can be found at your local Kenwood dealer. For more information circle 141 on the reader service card or contact Kenwood Electronics Australia.





## Mini hifi systems include 'Super Woofer'



Two new mini hifi systems from Panasonic feature five-disc CD changers and also offer what's described as a Super Woofer.

The highest featured of the two models is the SC-AK45 which has an output of 100 watts x 2 (RMS), while the SC-AK25 has an output of 70W x 2 (RMS). Both have a preset equaliser with a choice of disco, hall, live, heavy, clear and soft acoustics. The SC-AK45 has a four-way speaker system and the SC-AK25 a two-way system, plus the Super Woofer in each case.

The new systems have a five-disc 'stacker-style' CD changer with Panasonic's

'Digital Servo' plus MASH single-bit DAC technology for outstanding sound quality. The number of buttons on both systems has been kept to a minimum by having one set of controls which operate the CD player, AM/FM tuner, double cassette deck and timer. The control functions change according to the mode selected. Both have a full function remote control.

The two models are available from leading electrical retailers for an RRP of \$659 for the SC-AK25 and \$769 for the SC-AK45. For more information circle 146 on the reader service card or contact Panasonic's Customer Care Centre on 132 600.

## Car cassette receiver includes CD controller



Pioneer's new KEH-P5750, KEH-P4750 and KEH-P3750 auto-reverse cassette receivers with multiplay CD control give you the choice of listening to cassettes or taking advantage of their sophisticated CD playback capability, while commuting.

The cassette receiver functions include Dolby B Noise Reduction to reduce tape hiss on Dolby B recordings, while a dual-groove SHC tape head ensures faithful sound reproduction. The auto-reverse cassette functions are executed by Full Logic Controls (KEH-P5750 and P4750), in which a microchip in the unit allows fewer couplings and therefore quieter operation and higher reliability.

The KEH-P5750, KEH-P4750 and KEH-P3750 will connect to a Pioneer mul-

tiplay CD changer that can be mounted out of sight in the boot, under a seat or in the glove box. As multiplay CD controllers, the units provide Automatic Disc Program Selection (ADPS) for 100 discs, and Instant Track Selection (ITS) which lets you quickly select and play your favourite songs as often as you like.

Voice Control, via an optional CD-VC50, allows you to literally call up by voice command your choice of disc.

RRP for the KEH-P5750, KEH-P4750 and KEH-P3750 cassette receivers are \$529, \$449, and \$369 respectively. For more information circle 140 on the reader service card or contact Pioneer Electronics Australia, 178-184 Boundary Road, Braeside 3195.

## Digital PHS cordless phones from Panasonic

Panasonic hopes to revolutionise our office communications with its launch here of digital cordless handsets. These work on the PHS (Personal Handyphone System) digital wireless system developed in Japan, but in Australia they'll operate behind a PABX system as a digital cordless phone.

The Panasonic KX-T7500 digital cordless handset is compact and light in weight. It measures 130 x 50 x



28mm and weighs only 162 grams. Because it's digital, the clarity of reception is superior to analog devices and the calls are more secure against eavesdropping. The phone has an LCD screen and a flip-down section which covers the keys when not in use.

The new cordless digital handsets can be added to an existing Panasonic digital phone system (KX-TD816 or KX-TD1232, which have been sold in Australia since 1995). This can be done without even adding extra lines or running additional wiring.

For more information circle 152 on the reader service card or contact Panasonic's Customer Care Centre on 132 600. ♦



# Sony's **DVP-S715** CD/DVD Player

**This month reviewer Louis Challis was able to run his instruments — and his critical faculties — over the Sony DVP-S715, an excellent example of the new 'second generation' of DVD and CD players now appearing on the Australian market. It turned out to be a real eye- and ear-opener, and has certainly changed his personal intentions about buying a DVD player...**

**1**998 looks like being the latest watershed year for home entertainment. 1997 may have been the year in which we saw our first DVD players, but in the absence of appropriate software one would be forgiven for regarding that exercise as a big yawn. On the other hand 1998 has seen the initial and what proved to be an important release of locally produced DVD software, from Village Roadshow. Then in early May we saw the simultaneous release of imported hardware and software.

Few purchasers would have been willing (or even justified) in purchasing a DVD player without software. Now however, with a selective range of basically good and some outstanding software available, DVD will hopefully reformulate and regenerate the video rental industry in Australia and New Zealand. This regeneration will not come as

a result of some fundamental problem with VHS format video tapes, but rather because that format lacks the performance and technical panache which DVD now offers.

I appreciate that as yet most readers will not have seen a DVD playing the high quality software which is now available, and probably only a handful will have heard the outstanding (theatre quality) 5.1 channels of Dolby Digital (AC-3) sound which the latest releases of both Australian and imported DVD software now incorporate. If you haven't heard it in an appropriately equipped demonstration suite at a major specialist retailer, then you will simply not understand what I am attempting to describe in this review.

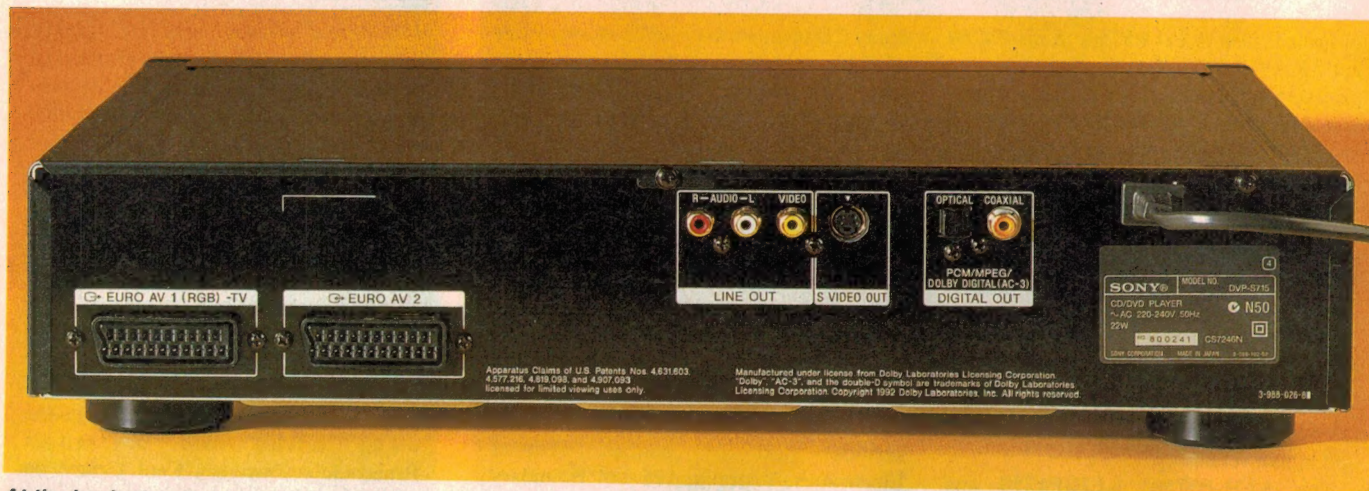
In my last review, I assessed an excellent home entertainment system that was not specifically designed to cater for the 5.1 discrete channels provided by the new DVD's

audio soundtracks. Whilst I acknowledge that the Yamaha AV-1 home sound system performed admirably with Dolby Pro-logic inputs, it would be inappropriate to suggest that either a Laserdisc, or a video cassette, whose soundtracks are encoded with Dolby Pro-logic could ever seriously compete with or compare with a well prepared Dolby Digital soundtrack.

## **No AC-3 decoder**

The Sony DVP \$715 CD/DVD Player is a potent 'techno-toy', although it should be carefully noted that it doesn't provide internal decoding for the Dolby Digital audio signal outputs. Notwithstanding, it does pack numerous advanced technological features into what I would describe as being a relatively unpretentious case.

With the DVP-S715's case opened, I



**At the back, there's an impressive array of connectors: SCART sockets for RGB out and loop-through, RCA sockets for analog composite output, an S-video output and both optical and RF digital bitstream outputs.**





observed an equally unpretentious series of modestly sized printed circuit boards. What surprised me was the disproportionate relationship between the size of the printed circuit board in this second generation Sony DVD player, and that used in the previous first generation of Sony's DVD players. I had a feeling of *deja vu*, as I had observed the same trends 12 years ago with the first and second generations of Sony's CD players. The first generation had at least four large printed circuit boards, while in the second and subsequent generations that generally reduced to one main printed circuit board — through the development of multi-functional LSI (large scale integrated) circuit modules.

The DVP-S715's major attributes are as follows:

1. Firstly, its outstanding performance as a conventional CD player. This attribute is primarily achieved as a result of Sony's adoption of dual discrete optical pickups. The signal detection characteristics of these optical detectors have been individually optimised to satisfy the vastly different requirements of CDs or DVDs.
2. The incorporation of two different user-selectable high frequency digital filters. The user may then select the filter response and the consequent sound characteristics which you regard as being most appropriate. Depending on your knowledge of the fundamental issues involved, you will either be thrilled by such a concept or alternatively, take the view that you couldn't care less.

The filter responses provided are either a relatively sharp rolloff which relatively few users will favour, or alternatively a filter

offering a shallower and more gentle rolloff. The latter ensures a far more natural sound and is the one which I would strongly commend. (see graphs appended).

Following the public discontent with the first generation of CD players which incorporated sharp cut off filters, Sony are only too well aware of the benefits that accrue from providing an appropriate choice of filter characteristics. The fundamental problem with sharp filter responses is that they invariably generate multiple spurious audible artefacts in their output signals.

3. The adoption of a new generation of high precision 10-bit 27MHz video D/A converters, in lieu of the more common 8-bit converters that some manufacturers have adopt-

### **Sony DVP-S715 DVD/CD player**

A 'second generation' DVD and CD player. Measures 430 x 325 x 98mm (W x D x H), weighs 4.8kg.

**Strong points:** Outstanding performance, as both a DVD player and a CD player. Excellent on-screen setup and configuration facility. Multifunctional 'universal' remote control.

**Weak points:** Lacks inbuilt Dolby Digital decoding.

**RRP:** \$1499

**Available:** Selected Sony dealers.

ed. The advantage of a 10-bit DAC is that it reduces decoding errors and provides a substantially enhanced signal to noise ratio. This of course leads to a more faithful reproduction of the original video signal.

4. The provision of a Digital Video Noise Reduction system, about which the manufacturer says relatively little. Those enhanced characteristics are most certainly visible in the video signals which I have

examined. It appears that this particular feature was not incorporated in Sony's first generation DVD players.

5. Audiophile ES Class audio outputs, based on the use of single-bit Delta-Sigma digital to analog converters (DACs). One novel feature of this converter is its ability to support 24-bit/96kHz resolution software. As attractive as that capability may appear to be, it is only fair to point out that there is no 24-bit 96kHz resolution software currently available, nor is there likely to be for quite some time...

6. The incorporation of a click-jog shuttle control on both the remote control and the DVD player's front panel. This provides convenient access to on-screen menus, as well as a greater convenience when using the DVD player's multiple controls and functions.

7. A wide range of on-screen display options during initial setup, including: (a) the option of output via the Scart sockets, conventional RCA outputs, coaxial digital output or optical output; (b) setting the aspect ratio of the TV set to either 4:3 letterbox, 4:3 pan and scan, or 16:9 widescreen; (c) a screen saver function, which disconnects the DVD player's optical output signals should it be left in the pause mode for more than 15 minutes, to minimise the possibility of premature damage to your TV or monitor display; and (d) the incorporation of a parental control password (a selected four-digit number) which will determine the parental control level in terms of seven possible levels of acceptability which encompass RESTRICTED, PG, PGR and PG13.



## The Challis Report

8. A universal remote control which will adapt to any brand of TV set for which code numbers are provided, to ensure system adaptability. This particular remote control offers the dual attributes of large physical size, with keys and lettering that are large enough to be correctly actuated, and a multi-functional capability so that you don't need to have two or more remote controls sitting at your side or in your lap.

### How it performed

Sony claims that the DVP-S715 DVD Player offers outstanding performance, and that it outperforms the previous generation of DVD players. That sort of statement is readily capable of being verified by the application of judiciously selected objective tests.

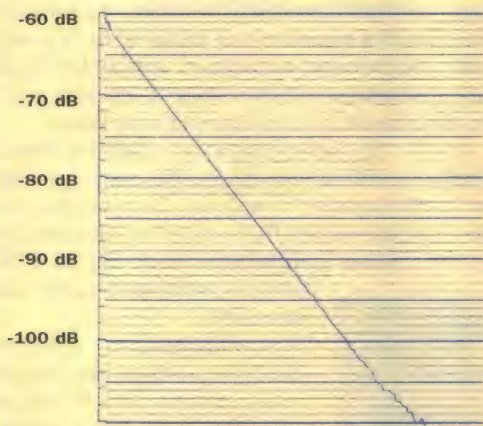
The first series of tests that I carried out evaluated the S715 as a CD player. Sony's literature claims that the previous model DVP-S700 was rated as being an outstanding CD player by two major audiophile magazines in the USA. On applying appropriate software and instrumentation to the task, I confirmed that the DVP-S715 exhibits an



*Inside the box: a modest number of unpretentious PC boards, thanks to the use of second-generation signal processing ICs.*

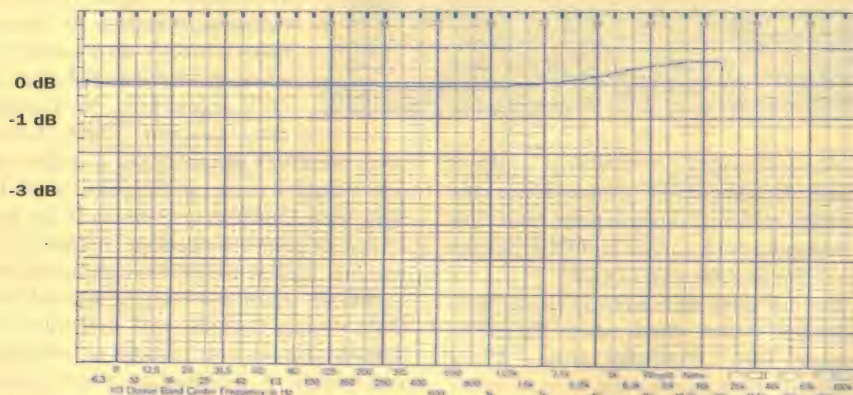
outstanding signal to noise ratio, which exceeds 110dB(A). At the same time I measured its output frequency response, which is particularly smooth — extending from 5Hz to 20kHz, with its maximum deviation lying within the range +0.6 and -0.1dB.

### Fade To Noise Test



*As a CD player, the DVP-S715 is truly outstanding. The replay response (below) is within 0.6dB from 5Hz to 20kHz, while the fade to noise plot (left) shows ruler-flat linearity down to at least -106dB. The tracking ability is also most impressive.*

### Replay Frequency Response



Whilst those parameters are important, they are less important than the linearity of the digital to analog conversion.

Most CD and DVD players exhibit excellent linearity over the range 0dB to -60dB, and nowadays that is virtually taken for granted. The more important portion of the digital to analog converter's dynamic range occurs below -60dB. That is what 'separates the men from boys'.

Happily in this respect the DVP-S715 is unquestionably outstanding. An examination of its 'fade to noise' performance reveals that it is positively exemplary, and essentially ruler flat all the way down to -105dB. Frankly that performance appears to upstage every other CD player (and DVD player) that I have ever tested.

What surprised me was that this test confirmed that the linearity was still acceptable and that curvature in the response was only just becoming apparent, at -110dB.

The DVP-S715 also exhibited uncompromising 'trackability' performance when faced with some of the nastiest visual obscuration and artificial fingerprint track ability tests. It happily tracked the Sony/CBS test disc with 3mm wide wedges, without a trace of either a click or a pop. Similarly it withstood vibration levels exceeding 0.5g with absolutely no trace of mistracking.

### Impressive tracker

One of the more important tests for this review involved an assessment of the DVP-S715's ability to track discs whose jitter and pi parameters are classified initially as being 'marginal' and then as 'bad'. The test discs I used were manufactured by Pacific Mirror Images (PMI) in Melbourne, who provide the disc replication facilities for the Village Roadshow organisation.



The test disc which has been classified as being 'bad' displays jitter values which range between 9.9 and 11.7, and a maximum pi error value of 480. By rights, the DVP-S715 should have had difficulty in tracking this disc, but to my pleasure and surprise it played the 'bad' disc with no signs of mis-tracking. Highly commendable!

For CD testing I used two new discs from Sony Classical featuring Yo-Yo Ma and Emanuel Ax, playing Beethoven's Five Cello Sonatas and Variations (Sony S2K 42446). As I soon discovered (to my chagrin) in a series of direct AB comparisons between the DVP-S715 and my current Sony CD player, the S715 definitely appears to outperform my existing CD player — the music sounded sweeter on the DVP-S715.

### Subjective tests

To carry my subjective assessments of the DVP-S715, I used a Harman Kardon AVR85 amplifier, which incorporates the Dolby Digital decoder. The AVR85 has five separate channels, each of which is capable of providing 85 watts of peak output. I used a pair of JBL HLS 610s for the front left and right channels, a pair of JBL HLS 410s for rear channels, and a JBL HLS centre speaker. For the subwoofer I used a B&W model ASW1000 which provides a furniture and window-shaking low frequency output.

For the video monitor I used a Sony Model KV/T25SF1 TV set, which although reasonably good, is not in the same class as Sony's new Wega flat screened model (as reviewed in May), or even the latest generation of high-tech Plasma screens which we will review in a subsequent article.

The subjective evaluation software I used included two discs from Village Roadshow and two discs from Columbia Tristar. The first and by far the more entertaining of the Village Roadshow discs was *The Mask*, whilst the second was *Shine*. Those discs are both outstanding, but as I discovered are only encoded with stereo (two-channel) soundtracks.

By contrast the two imported discs from Columbia Tristar were encoded with Dolby Digital's 5.1 channels of audio signal. The discs were *Jumanji* (D42049) and *In the Line of Fire* (D19668). With the 5.1 channels of audio correctly configured and adjusted using the Dolby Laboratory's test disc, I soon had an absolutely outstanding theatre sound system.

The quality of the sound reproduction achieved using both the *The Mask* and *Shine* was particularly good, but in contrast the multi-dimensional audible realism achieved with *Jumanji* and *In the Line of Fire* was absolutely fantastic. As I watched those DVDs I frequently found

myself unconsciously ducking to avoid the impact of bullets, flying objects, large animals and explosions to which I was surrealistically exposed...

I subsequently evaluated an American (Area 1) NTSC version of *In the Line of Fire*, using a Sony DVP-S300 DVD player. In keeping with my expectations, the 625-line PAL video provides a far superior visual quality to that offered by the 525-line NTSC version of the software.

### Summary

A month ago, if someone had suggested to me that I should consider buying a new DVD player, I would have told them I have no intention of doing so. But if you asked me today, then my response would be entirely different. After testing the Sony DVP-S715, I am now satisfied that not only do we have premium quality DVD players available, but more significantly we have both Australian and imported software which convert what would otherwise be just a concept, into an exciting reality.

Whilst you may well consider purchasing the DVP-S715 solely on the basis of its video attributes, that would be a mistake. The DVP-S715 also happens to be a truly outstanding CD player, and I have confirmed it has the ability to upstage and outperform any CD player that either you or I are likely to have previously auditioned. ♦

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# Communications: the **Crucial Link**

**Radio communications plays a vital role in the safe operation of aircraft in today's busy skies. However it's *really* crucial to the operation of emergency rescue choppers — which need much more flexible communications systems than other aircraft, because of the frequent need to operate under adverse conditions, and also to coordinate between a multiplicity of other services.**

**by Rod Pascoe**

**S**pecial mission helicopters perform critical and dangerous tasks. On call 24 hours a day, they have the most demanding requirements of any aircraft. The backbone of their operation is specialised communications equipment.

The challenge for the avionics industry is to provide an already cramped airframe with enough compatible communications hardware to allow its crew to talk to a range of ground and mobile radio systems. In Australia, this includes ambulance, police, fire, emergency coordinators, search and rescue, and customs, among others.

Frequently, emergency helicopters serve as coordinating agents linking different groups and using their altitude and visibility to improve response capability. The very nature of their work, retrieving victims of road crashes, fighting bushfires, rescuing sailors at sea, pursuing criminals or retrieving stranded bushwalkers, assures a heavy radio management burden.

As a result the required range of supplemental radio systems in the multi-role heli-

copter is staggering. It reflects the extent to which the communications industry has gone to introduce unique and often incompatible features and functions. And this is on top of the aircraft's normal VHF AM and HF SSB communications systems, required for communicating with air traffic services.

The frequency range required for the FM system includes low-band VHF at 30-50MHz, widely used for long-range, state or region-wide links; high band VHF at 138-174MHz for many commercial, corporate, marine search and rescue (SAR) and forestry applications; and UHF in the now expanded 403-512MHz range for hospital and other communications.

On top of the huge range of frequencies is still another challenge. Police and other missions often require encryption for sensitive data or conversations, and tone signalling methods of one sort or another to lock out unwanted traffic.

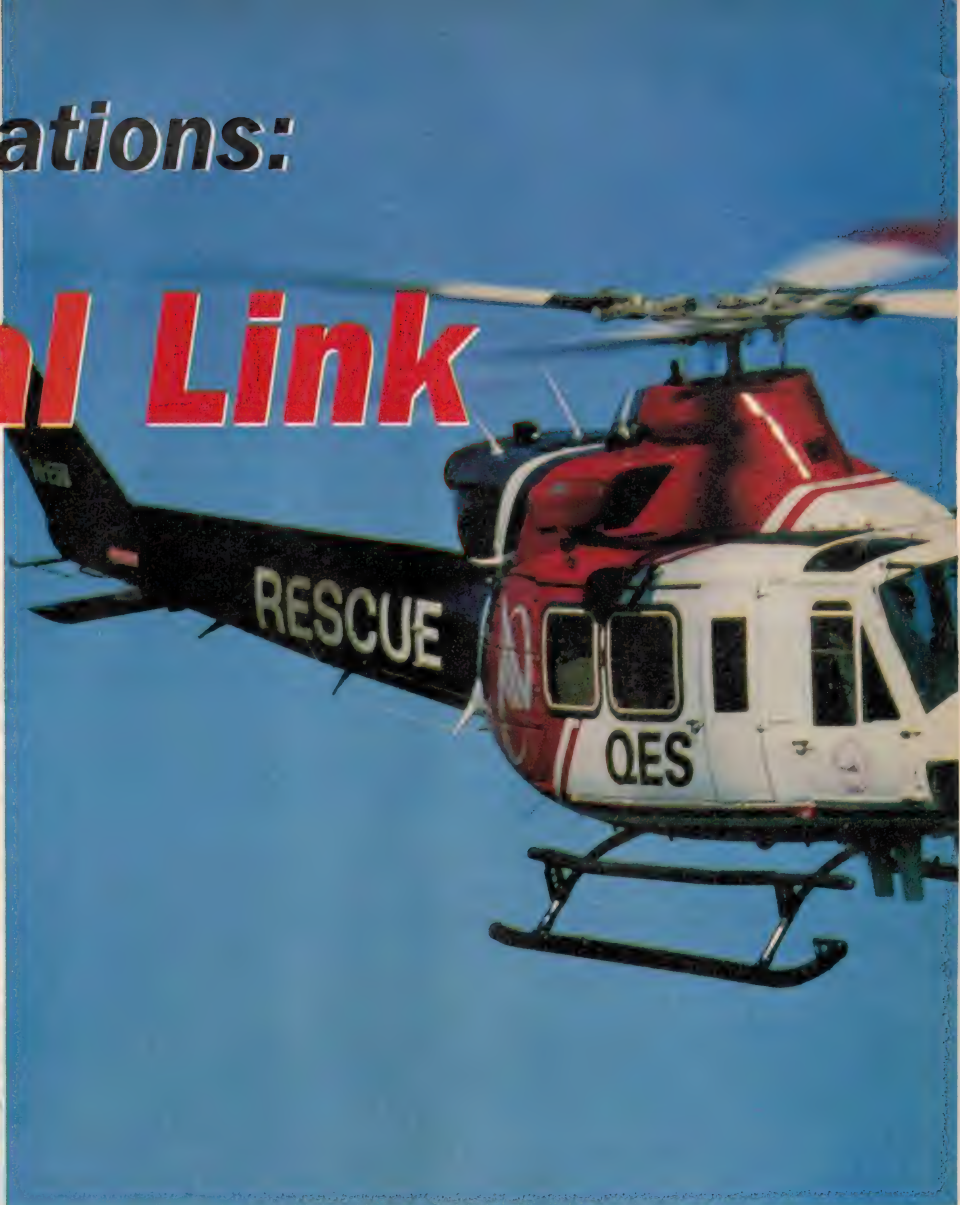
The Queensland Emergency Services has some of the best equipped multi-role helicopters in the world. The QES operates three Bell 412

helicopters, each with twin turbine engines.

Roger Cooper, QES Chief Pilot in Brisbane says, "We are better fitted than any other helicopter I have ever worked in — anywhere. We have a full range of all frequencies. We can communicate with air sea rescue, with the State Emergency Service, with the fire, police; anybody you can think of who is involved in communication, we can communicate with."

Communications requirements for the special mission helicopter usually can be satisfied with a single VHF FM high-band radio (if equipped with a guard) and suitable radio-selection and intercom (ICS) functions. That general requirement also means that the FM communications radio must meet the new 12.5kHz channel spacing and modulation standards and that it has adequate frequency coverage and full sub-audible tone capability.

For police applications, more band coverage is required to ensure the ability to communicate with other agencies like fire departments and hospitals. This was often







done in the past with Wulfsberg Flexcomm radios, or with Northern Airborne Technology's (NAT's) Tac/Com system. These allowed numerous band splits to be integrated into a single control head with multiple receiver-transmitters (R/Ts) to give the needed coverage. This has moved a step further with Allied Signal's RT-5000 and C-5000 system, which has full VHF and UHF coverage with a single R/T, as well as (untrunked) coverage in the 800MHz band.

In practice, many agencies require numerous channels in different bands to be active at the same time, as part of the coordination of on-site activities, and in many installations this remains a complex system issue to resolve. NAT's Tac/Com system allows up to three or four radios to be networked together in a single control unit, even from mixed manufacturers, and all can be on line simultaneously. Technisonic's new entry into this tactical radio area is a combined VHF and UHF FM radio, as well as split-band units, which are entirely self-contained within the control head. These can give full time, on-line FM coverage from 138 to 512MHz, and eliminate the remote R/T altogether.

In addition to the radio system itself, some method of controlling the radio selections, and handling internal ICS audio must be provided in the aircraft. These audio control systems and functions are highly task specific and range from a single, dual-user control, to four-to-six distributed stations in large medevac helicopters. The highly customised aspect of these units poses a recurring installation problem, and makes the design of the avionics package complex if good audio performance is to be achieved.

## Electrical load

The QES machines have additional hardware, such as a Nightsun searchlight, medical equipment, rescue hoist, external lighting, inverters for 240 volts, forward-looking infrared (FLIR) system, and video cameras and monitors. These are challenging systems to install on any airframe, due to their substantial size and weight and their considerable electrical load. They may also affect other systems or airframe performance, as they often reduce the maximum allowable airspeed, electrical load or payload of the aircraft.

To overcome the added pressure on the electrical system, a generator is fitted to each of the two gas turbine engines, increasing the generating capacity to 300 amps. There are two separate electrical busses — one specifically dedicated to essential aircraft systems.

In the air ambulance or medevac role, the QES helicopters usually need both VHF and UHF communication. Nearly all hospitals and their dispatch services seem to be on UHF channels, so this is often the primary work radio for medical communication and in-flight patient consultation. Often, this radio must be located physically with the medical staff, and is under their control as a result.

This UHF radio also may need to have various types of tone signalling capability, to open the different hospital repeaters within the city. This poses some operational problems, as it adds both sub-audible and DTMF (dual tone multi-frequency) tones to the system and greatly increases the chances that an operator error may occur due to the sheer complexity of the system. When the added difficulty and time pressure of on-site liaison with police and highway patrol at accident sites is added in, this is probably the highest-stress radio environment of all situations.

## Work load

To further complicate matters, rescue helicopters need to be fully outfitted for flying under instrument flight rules — flying without any visual reference outside the aircraft due to cloud or pitch black conditions. People tend to get lost or hurt themselves in the worst of weather...

This greatly increases the electrical load on the ship, adds a host of additional cockpit hardware, and ramps up the stress level a little further for the flight crew, who are already dodging power lines, antennas and other metropolitan hazards. Once in flight from the evacuation site, the flight and medical crews often split apart into independent ICS and radio groups, and work essentially in isolation until they reach their destination.

Adds Chief Pilot Cooper: "Then there's the mobile phone, which gets used more than anything else. It's a means with communicating with the people you are doing tasks for; sometimes you can actually communicate



Just some of the numerous antennas mounted on a Bell 412 rescue chopper operated by Queensland Emergency Services. (Courtesy Rod Pascoe.)



## The Crucial Link

with the people you are rescuing by mobile phone, which is something you would never have thought of many years ago. It's probably one of the best safety devices for anyone in a boat or in a bushwalking situation."

"The mobile phone has been modified so that anyone can listen into it — fireman, doctor, pilot can all talk on the phone. It's a voice activated phone — you can have it on hot mic or cold mic. We often operate on cold mic to cut out all the background noise particularly during winching."

It's interesting to note that the originally installed digital phone was replaced with an analog unit, because of the lack of coverage in some of the less populated areas of the state.

Roger Cooper continues: "HF is starting to be phased out or unused, however the Cairns and Townsville aircraft still do a lot of work on HF because of the distances and mobile phones problems and short distance problems speaking to medical ambulance people. If you are on VHF or UHF you're restricted in that part of the world."

"We are just about to set up a satellite phone to the Cairns machine which might be on-line as we speak. The reason it is being installed is because of the communications problems experienced up there. Even though



*The console between the crewman and pilot seats houses the control units for most of the avionics systems. The electronic and radio equipment they control is tucked away in any available space on the airframe.*

HF has some advantages sometimes we find we can't get through."

SAR aircraft also may have special locating systems like supplemental VHF direction finding equipment, to home in on emergency locator transmitters (ELTs) or handheld radios, and may also carry some type of infrared or night-vision gear to aid in searches.

Global Positioning System (GPS) is especially useful for SAR activities, as it permits rescuers to mark and quarter essentially blank areas like ocean or ice with good accuracy, and to give coordinates to others at sea or on the ground. GPS also is very popular with almost every other mission-specific group for much the same reasons, as it provides waypoints and markers where no other tool works effectively.

### The people

So who operates all this high-tech equipment, and who flies the helicopter? Despite the size of this huge twin engine machine, it's only single pilot operation. In the case of the QES, the pilot must be rated for flying in under IFR (instrument flight rules) as well as on all the internal and external equipment on the machine — winches, slung-loads, GPS navigation etc. The pilots have a wealth of experience, a minimum of 3000 hours, and most come from a military flying background. However he does get some help from a non-flying crewman.

"The crewman's responsibility is the lynchpin of the operation, which keeps it all flowing together. He operates the FLIR, the Nightsun, operates the navigation system, the GPS, operates the C5000 radios and homer. This allows the aircraft captain to concentrate on aircraft safety and navigation of the aircraft", explains Roger.

Because of the nature of their tasks — bushwalkers retrieved from mountain tops, sailors plucked from sinking ships, communities winched from rising floodwaters, this invariably involves operations in poor weather and at night. Pilots and machine, along with medical and other crew and all the sophisticated avionics on board, must maintain 100% integrity when it comes to saving human life. ♦

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SONY.



◆ Digital  
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# SONY DVD

The only player engineered to Hollywood standards.

Meet the total home cinema solution. Unlike other digital systems that merely mimic the movie theatre's digital sound, the DVP-S715 - in conjunction with Sony's uniquely developed Digital Cinema Sound (DCS) - actually recreates the acoustic characteristics of Sony's Hollywood studios where films like "Gone with the Wind",



"Terminator II" and "Men in Black" were mixed. It not only offers playback of DVD's, but is also compatible with audio CD's and video CD's. In fact, the DVP-S715's performance equals Sony's award-winning ES (extremely high standard) CD players. Bring a touch of tinsel town to your home cinema with the new Sony DVP-S715. **It's a Sony**



# The **EMPower Modulator**

*...pseudoscience that plugs into the wall!*

**Have you been intrigued by our discussions in Forum, of various electronic devices which are claimed to achieve amazing cures for various ailments? Well, here's a discussion of some more interesting gadgets made in Australia. One is a plug-in gizmo claimed to tame the nasty fields from your appliances, by modulating them with 'non-Hertzian frequencies'; the others are metal discs, with all kinds of magic properties...**

**by Daniel Rutter**

**T**he 'EMPower Modulator' is a device manufactured by Harmonic Energy Products, an outfit based in Queensland which has apparently been in business for more than 10 years. The device looks vaguely like an aquamarine-coloured Toblerone, with a strong Star Trek influence and a cable coming out of each end. There's a three-pin electrical plug on one cable and a three-pin socket on the other. It costs \$295.

Once the EMPower Modulator is plugged into a power point, an appliance plugged into the socket and the chain turned on, all kinds of beneficial effects are claimed to occur — all over the building where the thing's plugged in. You only need one Modulator to cover a complete house or office.

The purpose of the Modulator is (to quote the promotional literature) *...to alter or 'modulate' the electromagnetic fields generated by wiring, domestic or other appliances of all types, business machinery and equipment, particularly computers or VDUs! This creates a biologically stress-free environment in which physical functions are NOT subject to the normal interference and stress caused by the devices which surround us, and allows our natural energy to be utilised on a conscious level, rather than being wasted in coping with stress at a cellular level beyond our control... and so on.*

With the EMPower Modulator in effect, according to the makers, any and all damaging, stress-causing electromagnetic radiation is 'modulated' in such a way that it no longer has any ill effects. The notion that low-level EMR actually has the ability to cause ill

effects is still highly controversial to say the least, but have no fear — the Modulator will keep you safe from whatever might ail you.

Furthermore, Harmonic were happy to claim that the Modulator had a variety of other beneficial effects. For instance, refrigerators in a Modulator-equipped household can apparently be set to minimum cooling

This article is an abridged version of the text which can be viewed on my Web site at [www.drink.com/~drutter/quacks.htm](http://www.drink.com/~drutter/quacks.htm).

Harmonic Energy Products don't have a Web site of their own, but their address is 35 Price Street, Nerang Qld 4211, Australia. They also have a Freecall number; it's 1800-248-144. Their regular phone number is (07) 5596-6726. Harmonic Products resellers may be found on the Web at:

<http://www.fordbiz.com/>  
<http://www.bit.net.au/~markman/>  
<http://www.megadisc.com.au/>

and still work perfectly, with perishable vegetables lasting much longer. The Modulator also apparently causes positive-ion-emitting electronic devices (monitors, photocopyers...) to start emitting negative ions. This, I suppose, turns the monitors into anode ray tubes...

## **How it doesn't work**

The big question here is how this gadget works. And the big answer, or the big catchery in any case, is 'non-Hertzian frequencies'.

It is obvious to anybody with any knowl-

edge of physics that the term 'non-Hertzian frequency' is akin to 'circular square'. A frequency, by definition, can be described in Hertz, or cycles per second. If it can't, it's not a frequency. There's no way around this. If you've discovered some other emanation unknown to science that *doesn't* have a frequency measurable in Hertz, then obviously you should not call it a frequency. It's not the right word.

## **Poking & prodding**

Keen to find out more about this strange and mysterious area of parascience, I attended a demonstration of the product.

The New South Wales Ecological Testing Clinic (where the demonstration was held) provided us with an info sheet on the Listen System, the testing computer used to show the beneficial effects of the EMPower Modulator and, thus, the linchpin of the whole demo. The Listen System isn't made by Harmonic — it's an American device, which seems to be quite popular among practitioners of a variety of questionable therapies.

To be tested by the Listen, you hold a damp, cloth-covered electrode in one hand while your other hand is probed with a pointy thing by the trained operator. A graph is drawn on the computer screen in time with the probing, and the height of the peak and rate of fall and rise are interpreted to determine your state of health...

To quote the sheet, the Listen is 'the most comprehensive electro dermal screening device available', which measures 'the energy level reading of the body organs' by measuring electrical fields and





currents induced in the acupuncture meridians by the 'subtle energies' which constitute one's 'life energy'. Unusually low voltage readings may indicate degenerative disease, while unusually high readings may indicate inflammation.

Not only does the Listen tell you what's wrong with you in great detail — it also knows how to fix it. For 'inside the computerised memory programme there is an energy reference bank containing the magnetically coded vibrational signatures of thousands of remedies'. Whatever your 'unbalanced energetic system' may be, the Listen can prescribe the treatment.

What the Listen actually is, as far as I can tell, is a dressed-up resistance meter. It measures the electrical resistance between its probe and the electrode you're clutching in your other hand. The better moistened the probed area is and the harder you push, the lower the resistance and the higher the graph. When the demonstrators (foolishly) let me play with the probe, I replicated to my satisfaction all of the results they managed, using incorrect parts of my body, like the palm of my hand and my forehead. Incorrect test locations are supposed to trigger an alarm, but I didn't notice one.

I was told that the rise time had to be something like 33ms; I managed that. I was told the fall time had to be not much more than 0ms; I did that too. I was then told I was doing it wrong, but wasn't told how. Well, that settles that then...

### A review product?

You'd think, after all the claims, that Harmonic Products would be enthusiastic for reptiles of the press to depart with review samples of their Modulator. After all, with all of these wonderful anecdotal examples of the Modulator's extraordinary abilities, one would suppose an actual working demonstration gadget couldn't help but bring plenty of good publicity.

Wrong. Before I could get a review Modulator, I needed to be tested on the Listen system (OK, done that) — and also have a brain wave analysis and a Live Blood Analysis. Live Blood Analysis is the thoroughly discredited practice of using dark field microscopy on a drop of blood to diagnose a wide variety of illnesses.

Of course, if I just called Harmonic up, I could order a Modulator for A\$295, with postage, handling and insurance included. Regular consumers don't need any sort of testing — just the willingness to part with

the dosh. And, judging by the anecdote-laden promotional material, they don't need any fancy diagnostic gadgets to show them how great the Modulator is.

### 'Passed by authorities'

Harmonic make much of the fact that their Modulator has been passed by the relevant electricity authorities, and that it is sales tax exempt. They fail to mention that the electricity authorities only care about making sure a product will not electrocute the public; there are plenty of ordinary, and much cheaper, surge/spike filters that are so passed.

Some of these power conditioners are sales tax exempt, as safety devices. Some aren't, as well; the waters are a bit muddy on this subject and the Tax Office seems disturbingly willing to believe the claims of product makers in these cases. In any case, it doesn't matter, because the EMPOWER Modulator's exemption was not gained on the basis of the Modulator being a health-enhancing device. You see, it says in the small print that it is not so promoted...

### We deny everything!

Throughout their literature, Harmonic Products carefully avoids making any explicit curative claims about their products. While allusions to 'thousands of satisfied customers' are rife, and attributed quotes about stress relief, alleviation of repetitive strain injury and the like are also common, there are no actual direct therapeutic claims. This doesn't, however, stop them from saying "you may experience an enhanced sense of wellbeing, better concentration, significant reductions in eyestrain, migraines and fatigue, little or no discomfort from RSI, and reduced hyperactivity or hypertension in children, adults and even pets" and claiming that "all living things function and grow better in an atmosphere free from electromagnetic and biological stress!!" — with the obvious implication that said atmosphere can be created by the use of their products. They even go so far as to state that *many users noticed increased efficiency in their appliance performance when the device is fitted... ..reducing the wasteful leakage of electricity from the wiring*, which apparently is the reason for the abovementioned spooky increase in refrigerator effectiveness. All this on top of the health benefits!

But in the small print on the order form, you'll find *These products ARE NOT LISTED UNDER THE THERAPEUTIC GOODS ADMINISTRATION OF AUSTRALIA and must be accompanied by the literature provided. THEY ARE NOT CURATIVE, providing continuing temporary relief only. Recurring symptoms of any kind should be treated by a practising physician.*

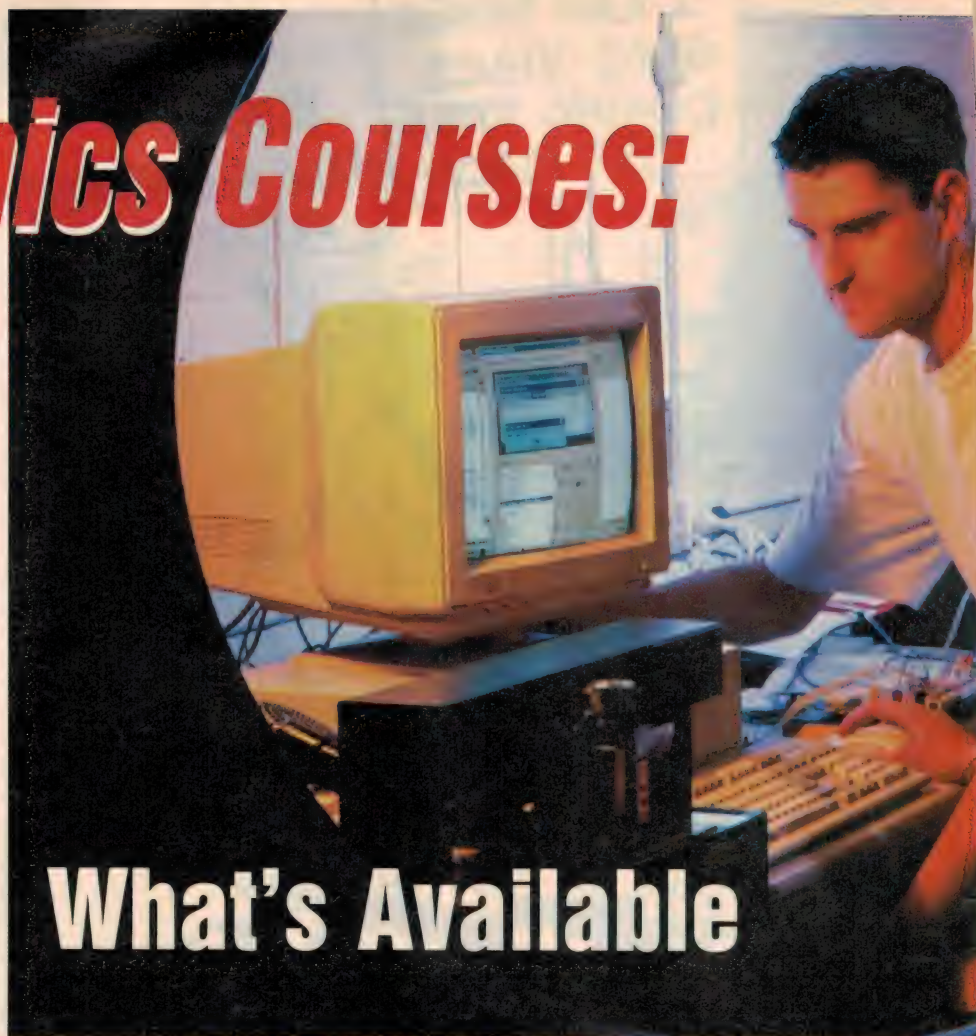
(Continued on page 30)



# Electronics Courses:

**You like electronics, it's something you find interesting and perhaps a little challenging at times — but have you considered taking that interest a little further? It's certainly worthwhile looking into some of the courses available, whether you've just finished school and are looking for a career in the industry, or you simply want to learn more about electronics.**

**by Graham Cattley**



## What's Available

If you are reading this magazine, then you obviously have an interest in electronics. This could be anything from a simple curiosity to an all-consuming passion for anything electronic.

Assuming you're thinking of expanding your electronics knowledge, there are a huge number of options open to you in terms of tertiary education in the electronics field. You certainly don't need to be a rocket scientist to get started, either. Simply completing year 12 will often be enough to get you through the door in most places, and just about all institutions are quite generous in giving credit or advanced standing. So if you've had any prior study or experience in the industry, you may well be off to a flying start.

So, where *do* you start? Well, we put out a few feelers and had quite a few responses from a number of universities, colleges and institutes around Australia — all offering a wide range of subjects on a number of different levels. I'll start off though with one of the biggest, most flexible and perhaps most familiar tertiary institutions in Australia: TAFE (Technical and Further Education).

### TAFE

TAFE is the one of the largest educational institutions in Australia, and they offer quite a number of electronics and electrical based courses.

You can expect part time (i.e. evening) and full time subjects to take you from year 12 through to a full diploma in electrical engineering or electrical technology, with specialisation in a number of fields including

power, computing, microelectronics, electrical control, communications, and so on.

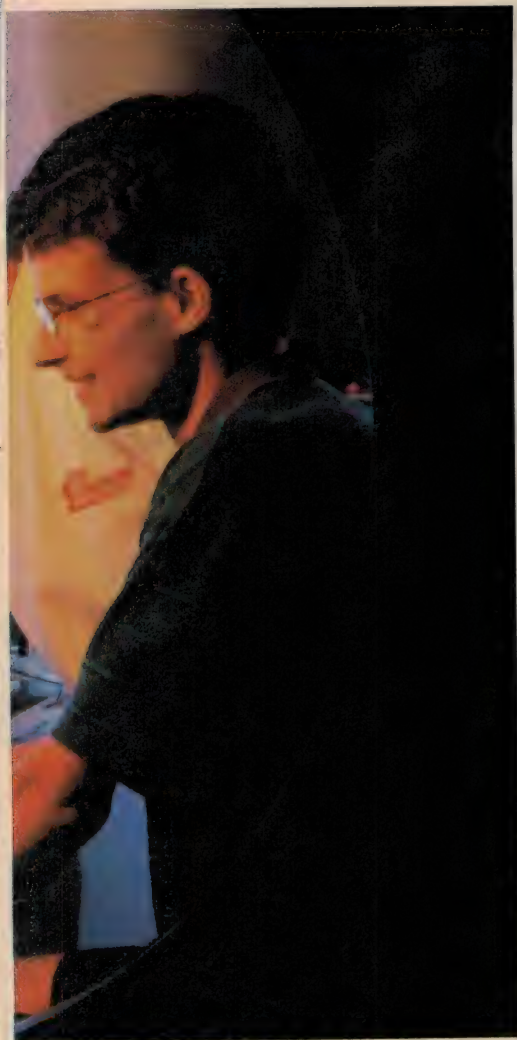
TAFE also plays a vital role in industry apprenticeship and trainee schemes, and their Trades division is an ideal place to start if you are currently working in the industry. You can receive an Electrical Trades Certificate after three years (part time), and this can be upgraded to an Advanced Certificate and then to a full Diploma in the Engineering Division. All subjects on offer are modular, and credit for completed subjects can be easily transferred from college to college, or state to state.

If you can't afford the time, or are located away from one of the many TAFE colleges around the country, you might like to consider OTEN, the Open Training and Education Network. OTEN provides a wide range of open learning, distance education and training programs, and many of the electrical and electronics subjects can be completed with the comprehensive notes and support material supplied. You may have to attend a college from time to time, but if you are unable to get to a college offering the subjects you want frequently, it's well worth considering.



*Students Ismail Shujau and Rosemary de Castella running tests on a circuit at Deakin University.*





## Box Hill Institute

Box Hill Institute of TAFE in Victoria was one of the TAFE colleges that we contacted, and they supplied us with a fair amount of information on the electronics subjects that they were running.

The Box Hill Institute's division of Electronics Technology offers a range of new and updated courses including Aviation, Computer service, Microprocessor technology, Telecommunications, Broadcast technology, Consumer electronics and an Engineering degree, to name but a few. You can enroll in most of their courses from year 11.

Both full and part time intakes for TAFE are in January and June, but if you are interested in taking a course it is best to get in touch with the college early to avoid disappointment.

Full contact details for Box Hill TAFE are listed in the information box, but if you want more information on TAFE in your state, your best starting point would be the TAFE handbook, updated every year and available from TAFE institutes and newsagencies around Australia.

## Open Learning

Mobile communications is big news these days, and so if you are looking to get into this rapidly expanding field, you might like get in touch with Open Learning Australia (OLA). They offer a total of 19 postgraduate qualifications, including a new Graduate Diploma in Mobile Communications.

This diploma has been recently developed to meet the increased demand in the mobile communications industry, and the recent expansion in the fields of analog and digital mobile telephony and pagers, along with trunked mobile radio and satellite mobile services has created a demand for engineers and para-professionals who are up to date with mobile comms.

OLA are backed by support from the major players in the mobile communications industry, including Telstra, Optus, Vodafone, Ericsson, Nokia, Philips, HP and the Telecommunications and Industry Training Board (TITAB). The new graduate diploma is made up of six core technical units, at least three management units and at least two elective subjects. The qualification is awarded by the University of South Australia, with subject material from the Australian Information Technology Engineering Centre.

## Griffith University

Griffith University in Queensland offers a number of Bachelor degrees in Engineering, Microelectronics, Science and Commerce. Most of these are run from their Nathan campus, and range from three to four years full time. You can do the Bachelor of Technology in Microelectronics or Bachelor of Engineering in Microelectronic Engineering, or you can opt for one of their dual courses, which combine a Bachelor of Engineering with a Bachelor of Commerce or Bachelor of Science.

These dual courses provide you with both qualifications in less time than would be needed to complete each course separately. They take five years of full time study, which includes a half year dedicated to the Industrial Affiliates Program, in which an engineering design project is undertaken with an industrial partner company.

Griffith University is justly proud of their students — much of the literature we received highlighted their students' achievements, which gave a first hand look at the institution and the people behind the scenes.

Entry is via TAFE courses or other partially completed university courses, but they are very flexible and will consider enrolment through work or life experiences as well. As they say, not completing year 12 doesn't have to stop you from studying at Griffith.

## Stott's College

If you need a flexible approach to your studies, private educator Stott's off-campus college offer a wide range of electronics courses including an introduction to electronics, television and VCR servicing, Digital electronics, PC maintenance, and cellular telephone and CD player servicing.

Stotts have been in the education and training business for 100 years or so, and have made a good name for themselves. The fees can be paid on a monthly basis, and cover the required texts as well as the lessons, tuition, and the final certificate. Scholarships are available from time to time, and you can start your course whenever you like. Check the Information box for the contact details.

## Deakin University

Since it was established in 1974, Deakin University has become one of Australia's largest universities, with some 30,000 students taking undergraduate and postgraduate degrees. In 1995 Deakin won the 'Australian University of the Year' award, and in 1997, it was awarded the top 'five-star' rating by the Graduate Careers Council of Australia.

In 1998, Deakin University is offering their Bachelor of Technology degree in mechatronics, computronics and manufacturing. These all take three years of full-time study, and graduates will qualify as engineering technologists, a fully accredited professional level in the engineering field.



*Jeff Smith was a winner of the IT&T awards along with fellow student Steve Howard. Their winning project was part of the Industrial Affiliates Program at Griffith University.*



## Electronics Courses

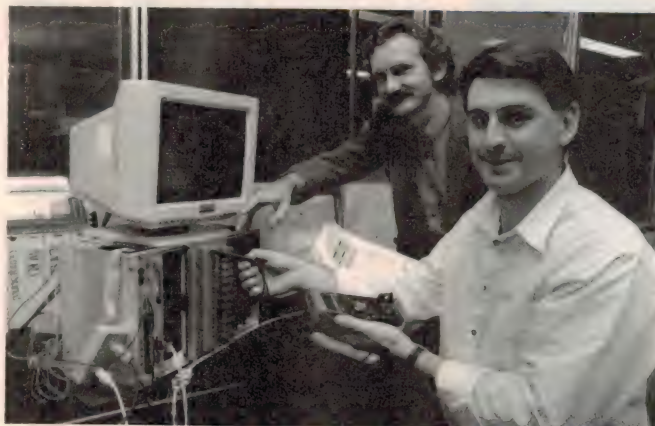
Their Bachelor of Engineering degree (four years full time) is also available in all the areas listed above.

As of next year, Engineering and Technology students at Deakin will take the same course in first year and can choose an area to specialise in at their second level. They can choose from a diverse range of subjects including environmental, manufacturing, robotics, mechanical, coastal resource management, electronics, mechatronics and computronics.

In their final year all students complete a workplace project, which involves solving a 'real-world' problem in an engineering firm or on the factory floor.

Deakin also offers what they call a 'double-header' degree in computronics or mechatronics, where you can effectively have two areas of expertise when you graduate — combined studies in electronics and computing, or electronics and mechanical engineering. Computronics and mechatronics are both branches of engineering that involve the design and operation of electronic systems, with computronics bringing together electronics and computing, and mechatronics integrating mechanical and electronic systems.

*Rosemary de Castella, a third year mechatronics engineering student is tutoring first-year physics students in a peer support program run by Deakin University. She has her sights firmly set on a career in aerospace and aviation.*



*Andrew West (left) of Foxbro L&N, with microelectronic engineering student Mark Hitchings. Mark worked with Foxbro L&N on a remote terminal unit while studying for his degree at Griffith University.*

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- Griffith graduates now work in exciting areas including computing, biomedical science, communications and project management.

For more information on Microelectronic Engineering contact Leanne Knight on (07) 3875 5004 or email: [L.Knight@me.gu.edu.au](mailto:L.Knight@me.gu.edu.au)



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- > Applications now open for undergraduate and postgraduate study.



Further information: Contact Trish O'Toole, School of Engineering and Technology, Deakin University, on telephone (03) 5227 2033, fax (03) 5227 2167, or e-mail [triss@deakin.edu.au](mailto:triss@deakin.edu.au)

**DEAKIN**



Deakin promote their flexible course delivery, which makes it possible to stay on the job while you study for a degree. You can study off-campus or on-campus, part-time or full-time, from anywhere in Australia or even overseas.

## Short courses

In the process of getting all the above information, we came across a couple of institutes offering short courses that might be of interest.

The Sydney Institute of Technology offers around 100 short courses in the computing and engineering fields, with a typical course running for around 10 to 30 hours. The classes are mostly run in the evening, and cover everything from an Introduction to PCs through to Engineering Project Management and Telecommunication and Data Cabling.

Open Channel in Fitzroy Victoria is supported by the Australian Film commission, and they run short courses on film, video and multimedia production. HTML design, desktop video, CD-ROM design and digital editing classes are available, as well as some full time subjects including video production.

They are offering over 80 courses this year, so if you are interested, see the information box for details. ♦

## CONTACT DETAILS

### TAFE

Contact the nearest TAFE college in your state, or phone:

ACT: (06) 207 3191

Vic: (03) 9628 4910

NT: (08) 8946 6666

SA: (08) 8226 3409

Tas: (002) 337 378

NSW: (02) 299 5011 or 131 600  
WA: 1800 999 167

### Box Hill Institute

Box Hill Institute PO Bag 2014, Box Hill, Vic. 3128

Phone: (03) 9286 9840

Website: [www.bhtafe.edu.au](http://www.bhtafe.edu.au)

### Open Learning Australia

An OLA student adviser can be contacted on (03) 9903 8955, or consult the OLA 1998 Handbook at [www.ola.edu.au](http://www.ola.edu.au)

### Griffith University

Phone the Secretary, Leanne Knight on (07) 3875 5004

Email: [l.knight@sct.gu.edu.au](mailto:l.knight@sct.gu.edu.au)

Website: [www.gu.edu.au](http://www.gu.edu.au)

### Stott's College

134 Flinders St., Melbourne, Vic. 3000

Phone freecall 1800 069 020 for information on courses.

### Deakin University

For general information on engineering and technology, contact Trish O'Toole on (03) 5227 2033  
Email: [triss@deakin.edu.au](mailto:triss@deakin.edu.au)

### Sydney Institute of Technology

Building I, Room IG-11, Mary Ann St., Ultimo, NSW 2007

Phone: (02) 9217 4170; Fax (02) 9217 4018

Email: [SIT.BusinessCentre@tafensw.edu.au](mailto:SIT.BusinessCentre@tafensw.edu.au)

Website: [www.sit.nsw.edu.au](http://www.sit.nsw.edu.au)

### Open Channel

Write to: Open Channel, 13 Victoria St., Fitzroy Vic. 3065

Email: [openchannel@openchannel.org.au](mailto:openchannel@openchannel.org.au)

Website: [www.openchannel.org.au](http://www.openchannel.org.au)

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<http://www.lg.tafensw.edu.au>



**A reader describes how to assemble your own**

# PC for \$100 part 1

**Would you like to get into computing, but can't really afford one of the latest you-beaut high speed Pentium MMX systems running Windows 95? There's a much cheaper way: assembling your own DOS-based machine, from second-hand parts. You'll learn quite a bit about PCs, too...**

**by D. Robert Gott**



**Fig 1: A typical AT-clone computer case, complete with 200W power supply (box at rear right) and disk drive mounting cage (front right). This example has a convenient swing-up lid.**

If you're like me, unemployed on Mature Age Allowance, or working but on a critically tight budget — or simply scared of computers — there's a cheap way to build your own IBM compatible PC (personal computer), MS-DOS based system for about \$100. This is also a good way to learn about computers, at the same time. In this and the following article I'll show you how to do it.

The help of an empathetic, computer knowledgeable friend or club is advisable. Also, I suggest that you borrow a computer dictionary from a library. Otherwise, read on — in a few months you can be typing, writing letters, keeping information in a database, playing chess and doing printing.

## **Getting started**

Where to begin? With the hardware side, looking for the basic components for your system. Markets, garage sales, newspapers, *EA* magazine and its BBS (via friend!), the free adverts in *Computer Market* magazine, friends and relatives and the junk bins of computer and electronics retailers — try them all.

There are heaps of 395 x 170 x 400mm (width x height x depth) ex-Government department Osborne cases available, for example, typically for \$5 each. For another \$10 try to get a power supply (PS) included. This is the typically 150 x 85 x 140mm box at the right-hand rear of the computer case, with a fan nearest the outside. Fig.1 shows a typical unit.

A few important points. Make sure the case has ALL wires attached to the reset and turbo switches, all lamps, AND has a mains power switch with Utilux type lugs. Do NOT buy a 'tower' case unless it's dirt cheap, or a slimline, or a huge XT with power switch on the side of the PS. Trust me!

Ensure that there are mountings for a 3-1/2" 1.44MB floppy disk drive (FDD) and a hard disk drive (HDD), preferably in a 3-1/2" bay with 5-1/4" to 3-1/2" adaptor



mounts — the best of both worlds!

The PS needs to be rated at 200 watts, with good long coloured leads (yellow/black/black/red) for DC, preferably with two smaller plugs (for 1.44MB FDDs) branching off larger plugs. The 240V input cable (blue/brown/black/white) goes to the computer power mains switch.

**WARNING:** The mains lead to the wall socket must be unplugged whilst you are connecting the power supply's mains 240V lead to the computer mains switch which is a DPDT (double pole double throw) type. Get an electrician or very experienced person to connect and check thoroughly before applying live mains.

## The motherboard

This is the really important main and largest PCB (printed circuit board) in the computer. If you can, obtain a 386DX33, 486SX33, or 486DX33 IBM compatible, baby-AT style board, typically 332 x 218mm, with eight 16-bit 'ISA' slots for plug-in cards, a good 3.5 volt battery, and four slots for 30-pin SIMMs (single-in-line memory modules). It should also have a ROM (read-only memory) or ROMs, with a standard and easy to use BIOS (basic input/output system), like that from AMI (American Megatrends Inc).

Make sure your motherboard has seven or eight plastic stand-off insulators for mounting it into the case.

If you are offered a good motherboard with VESA slots cheaply, take it. You can



*The author using his own self-assembled 386 computer, built at very low cost using the strategy described in this article.*

upgrade to better later, but it is not essential.

Bear in mind that you probably won't understand all this jargon for a while, but if you tell the seller what you really need, they'll understand, and hopefully your friend will anyway.

## Memory & cards

Computers do not work without memory (RAM)! I specified slots on the motherboard

for 30-pin SIMMs, as the newer 72-pin type are relatively expensive. A non-parity 1MB 30-pin SIMM costs \$5 or less. I suggest you get 2MB of memory (2 x 1MB SIMMS) for starters. Your friend will hopefully show you how to plug them in.

Only two plug-in cards are essential to get you started: an IDE controller, which will be needed to interface with the HDD and FDD, and a video card. For the latter, I suggest an HGA (Hercules graphics adaptor) card with a parallel printer port. This plugs into any of your eight slots, but I suggest the slot farthest from the power supply, as no cables connect to this card.

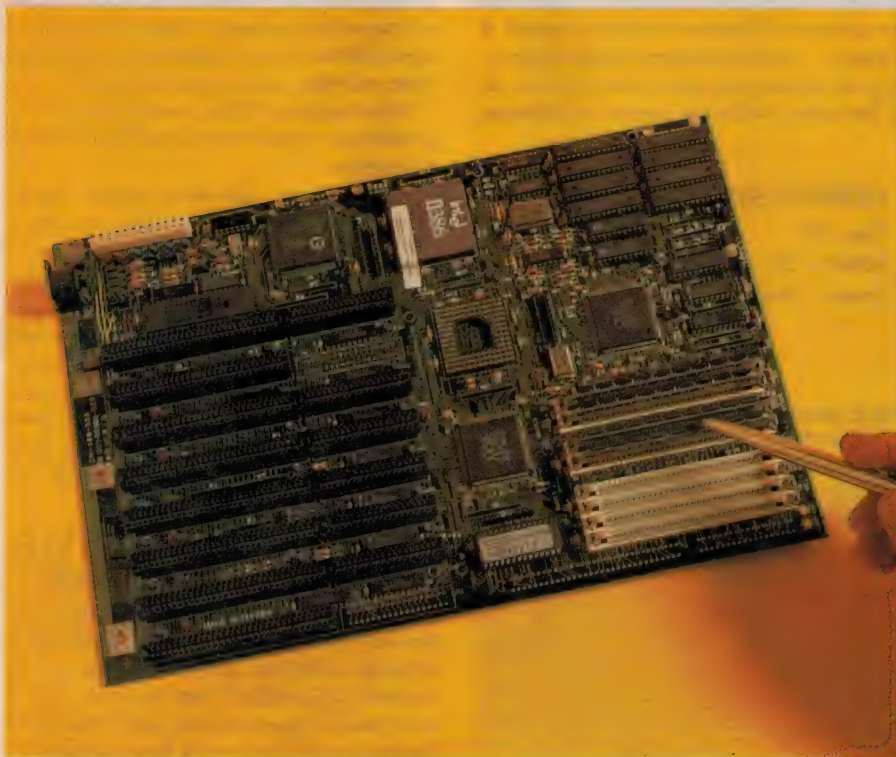
Let us recap for a moment. Have you now been able, with help, to fit your motherboard into the case, connect up the PS leads (Important: the motherboard DC power leads, generally two off, go inline and black-to-black), including the mains cable to the switch, plus reset, turbo, speaker leads etc?

If you have got this far, you are doing well. You can connect to mains power now and switch on. You did get a mains lead included in the cost of your PS? A lamp should come on showing that DC power is OK, but nothing else will happen until you get more hardware.

## Monitor & keyboard

Generally speaking people cannot sell monochrome monitors, so you should pick one up for free or \$3 — maybe \$5 at the most, complete with a mains lead that plugs into the IEC socket on your computer's PS. This is the best arrangement as the monitor then comes on with the computer.

My 14" green monitor was one of two given to me. They should have a fixed or plug-in lead which has a 9-pin 'D' type plug,



*A typical 'baby-AT' style motherboard, complete with 386 processor chip (top centre, with white tape). This one also has some 30-pin SIMM memory modules, as indicated, and a full set of level-2 cache chips (upper right).*



which fits into the HGA card socket.

For another \$3 you should get a working 101-key enhanced keyboard — easily recognised by having the function keys F1 - F12 along the top, and four arrow keys in the bottom middle group. The 5-pin DIN (German!) plug on the end of the keyboard cable fits into a similar socket on the motherboard.

Assuming you now have computer, motherboard, 2MB of RAM, Hercules card, monitor and keyboard, what do you get next? Conventional wisdom would say a hard disk drive (HDD).

First add up what you have spent so far — maybe \$45? So you have \$55 left for an IDE controller card, HDD, FDD, cables and printer with cables, and some software. A tall order! Maybe, but take heart, there is a lot of good very cheap s/h gear out there if you are patient.

Do you have a birthday or Christmas coming up? Just the right time to drop a hint that you need an FDD or some unwanted (legal) outdated software like Microsoft DOS 5.0. It beats a pair of socks or underwear hands down...

But anyway, to HDD or not to HDD — that is the question?

William Shakespeare might have settled for a brace of ballpoint pens, if only they had been invented.

Our dilemma is easily solved, really. It is no good having a printer if the computer will not run — and for that we need either a FDD or HDD. Well, believe it or not, a HDD is not essential if money is really tight. That's right!

I suggest you purchase an IDE (integrated drive electronics) card complete with a bunch of cables (maybe \$10), and a 3-1/2" 1.44MB FDD (\$5), and have a go at fitting them in your computer. Your ever-helpful friend had better help you connect the cables; it can be tricky first time. Once fitted, though, draw a sketch of the connections — i.e., which way round the 'red line' on the cables goes. You'll then be right for the future.

Of course, you will want a HDD sometime, or even immediately if you can afford it. So here is my suggestion. Get a 45MB or 90MB IDE HDD, preferably with a heap of useful software (which we will cover next month) including MS-DOS Version 3.3 or later. There are quite a few of these 'small' HDDs (by modern standards) available very cheaply nowadays, as many people have replaced them with larger units.

Is there an advantage in buying IDE card, HDD and cable together? Yes, if you can, because they will usually have been removed, working as a set from a defunct computer. Bear this in mind please.

Steer clear of older MFM (modified frequency modulation) controller cards and HDD's. It

would take too long to give reasons — these were the earliest 10, 20 and 40MB HDDs.

### Booting it up

So you now have a minimal computer system, with cards installed, cables connected to the FDD, keyboard and monitor connected, and rearing to go — well not quite!

Although the BIOS, which resides in a non-volatile (non eraseable) ROM chip on the motherboard, checks memory and peripherals, and reads disk drives for operating systems, it cannot run the computer. This is done by the DOS (disk operating system).

You might ask why it is a disk system, not a computer system. The quick answer is that electronic data has to be organised and stored permanently somewhere — usually on hard or floppy disks — so a DOS (Microsoft MS-DOS for IBM compatibles) is essential.

In short, you need a double-sided high density 1.44MB floppy disk (the commonest type now), which has been formatted for IBM and compatibles, and contains MS-DOS version 3.30, which easily fits on one disk. Insert this disk into your FDD, with the arrow to the top left hand side — making sure that you could see through the write-protection hole (i.e., the disk is write protected) before insertion.

Now for the moment of truth! SWITCH ON THE COMPUTER. Hopefully, the power lamp will glow, you'll hear the cooling fan blowing, you'll hear various bleeps and noises, the FDD will make whirring noises and its lamp will flicker on. Meanwhile your monitor screen will light up displaying a panel of settings — various messages which will probably be meaningless at the moment. Then all of the activity will cease except for a flashing



**A typical 3.5"/1.44MB floppy disk drive, viewed from the rear to show the connectors used to provide it with DC power (left) and exchange data with the computer (right).**

cursor (like a hyphen) on the monitor screen, after the message A:\>.

Hoorah! You've made it! Your computer is now at your mercy! Indeed, you are at what DOS calls the *command line*, in the *root directory* of your A: drive. Not surprising, as you probably only have one FDD at the moment.

There may be all sorts of other text (writing) on the screen. Let's get rid of it by issuing our very first DOS command, called CLS — clear screen. Type in 'cls' [space] [enter]. Note that in future, the actual words to type will be in italics, whilst actual keys to press will be in square brackets. Lower case letters are fine unless otherwise stated.

What happened? The prompt alone, A:\>, should have gone to the top left-hand side of your screen.

OK, let's do something really useful. Command your obedient 386 etc thus: 'dir/p' [enter].

The FDD makes a noise, its lamp flickers, and a mysterious list appears on your screen. If the screen is full, press [enter] again and the list will scroll down further. Right at the bottom you will see the total number of files, how many kilobytes they take up, and how many kilobytes are left on the floppy disk. You've just done a *directory listing* of the files on your floppy disk.

It is possible to create a virtual C: drive without a physical HDD, using the DOS RAM-DRIVE programme — see Fig (2) for a listing.

In the second of these articles I'll show you how to install an HDD, a printer, and which software to look for. Meanwhile if you can get a simple book on DOS from the library, you'll have plenty to keep you busy until then. I used *Teach yourself DOS* by Al Stevens (ISBN 1-55828-021-9), covering MS-DOS 3.30, but there are quite a few similar books. Keep away from DOS 4.0, though! ♦

### CONFIG.SYS file

```
files = 20
buffers = 15
device = ramdrive.sys 384 512 122 /e
```

**Fig 2: How to use Ramdrive with MS-DOS 3.3, to create a virtual hard disk.**

### AUTOEXEC.BAT file

```
echo off
cls
time
date
prompt $p$g
c:
copy a: *.*
cls
path c:\a;a:\dos
```



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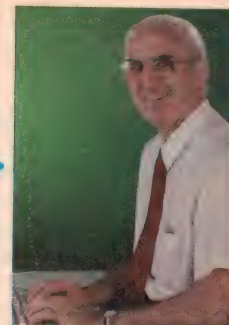
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## More on TENS/TNS, and some feedback of the skeptical kind...

As promised last month, we're now going to look a bit more deeply into TENS/TNS devices and their use in the treatment of pain. I'm also able to report on the use of one of Melbourne firm Bio Electronics' Sportsmed devices, for both TNS and CES. There's also some more feedback — this time from a reader who feels I've gone too far in exploring the claims of people promoting those 'alternative electrotherapy' devices we've looked at in recent months.

Sometimes I get the distinct feeling that whatever approach I take with Forum topics, I'm almost guaranteed to upset one group of readers or another. When I expressed skepticism about some of the more esoteric 'alternative electrotherapy' devices, in the January and February issues, there was a deluge of letters and emails from offended believers in these devices — accusing me of a closed mind, and callous disregard for sincere attempts to alleviate suffering in cases where traditional medicine had failed. But when I tried to answer such criticisms by considering some of the more credible devices, in a reasonably open-minded fashion, there have been another crop of letters — this time from people accusing me of 'selling out' to the 'ratbags and charlatans'!

Ah well, you can't please everyone, can you? So perhaps the best idea is to press on, in directions led by my own judgement and intuition, and simply hope for the best. With a bit of luck at least *some* of you will stick with me, and find our travels of interest and value...

Anyway, you may recall from last month that Melbourne firm Bio Electronics had very kindly sent me not only some literature on TENS/TNS devices and their use in the treatment of pain, but also a sample of their Sportsmed device. The Sportsmed is a reasonably priced, compact battery operated unit with adjustable timing, modulation and level controls, which can be used for both TENS/TNS (transcutaneous neural stimulation) relief of pain, and CES (cranial electrotherapy stimulation) relief of stress and anxiety. Bio Electronics has sold many thousands of the devices, and they're used widely by sportspeople both around Australia and overseas.

Needless to say I've been trying out the Sportsmed myself, and so have other members of my family. But before I relate our experiences with it, this is probably a good time to explain a bit more about TENS/TNS and the way it's believed to work.

First of all, as the name suggests, TNS (let's call it that for short) seems to involve applying a pulsed voltage between two electrodes placed at different positions on the surface of the skin, so that a small pulsed current flows between them, both through the skin itself (i.e., *trans-cutaneously*), and to certain extent just below the skin where it tends to stimulate activity in nearby nerve fibres (hence the *neural stimulation*) — both sensory or 'affective' nerves and motor or 'effective' nerves. As a result the former nerves are triggered into sending impulses to your spinal cord and brain, while the latter nerves send impulses to the muscles they feed, which tends to result in the muscles 'twitching'.

The current levels involved are generally quite small. For example the Sportsmed device, which is described as a 'microcurrent, micropulse stimulator', delivers alternating-polarity pulses with a fixed width of 250µs, an adjustable amplitude of 80V maximum, and a maximum current of 2mA. Typically it's set to produce less than 30% of this current level, though. The pulse repetition rate can be adjusted both manually over a 2Hz - 50Hz range, and/or set to vary automatically over a 5:1 span within this range.

Some of the other TNS units marketed seem to use higher current levels than this, especially those of earlier vintage. But this seems to be the ballpark currently favoured and regarded as the best compromise between efficacy and safety — especially for unit that are used for both TNS and CES, like the Sportsmed.

### How does it work?

Now if you're like me, you're probably curious to learn how stimulating the nerve fibres in this way can somehow alleviate pain. So how is TNS supposed to work?

I found a brief but reasonably clear explanation on the web, at a site run by the Anglo-European College of Chiropractic (<http://www.epemag.wimbourne.co.uk/ae->

[cctens.htm](http://www.epemag.wimbourne.co.uk/ae-cctens.htm)) — you might care to look there, if you wish. However I also found a simplified explanation in the literature sent to me by Trevor Andrews of Bio Electronics, which you'll hopefully find of interest.

Basically the theory seems to be that TNS works via two main mechanisms, which are usually described as the 'endorphin effect' and the 'gating' effect. Here's how the Bio Electronics literature explains them — but please bear in mind that 'synaptic junctions' are the interfaces between nerve cells and the fibres of other cells, across which impulses pass in moving around our central nervous system (or CNS):

**The 'Endorphin Effect':** This is a hormone release, which acts as a pain and stress control medication (tranquiliser) as it circulates in the blood stream.

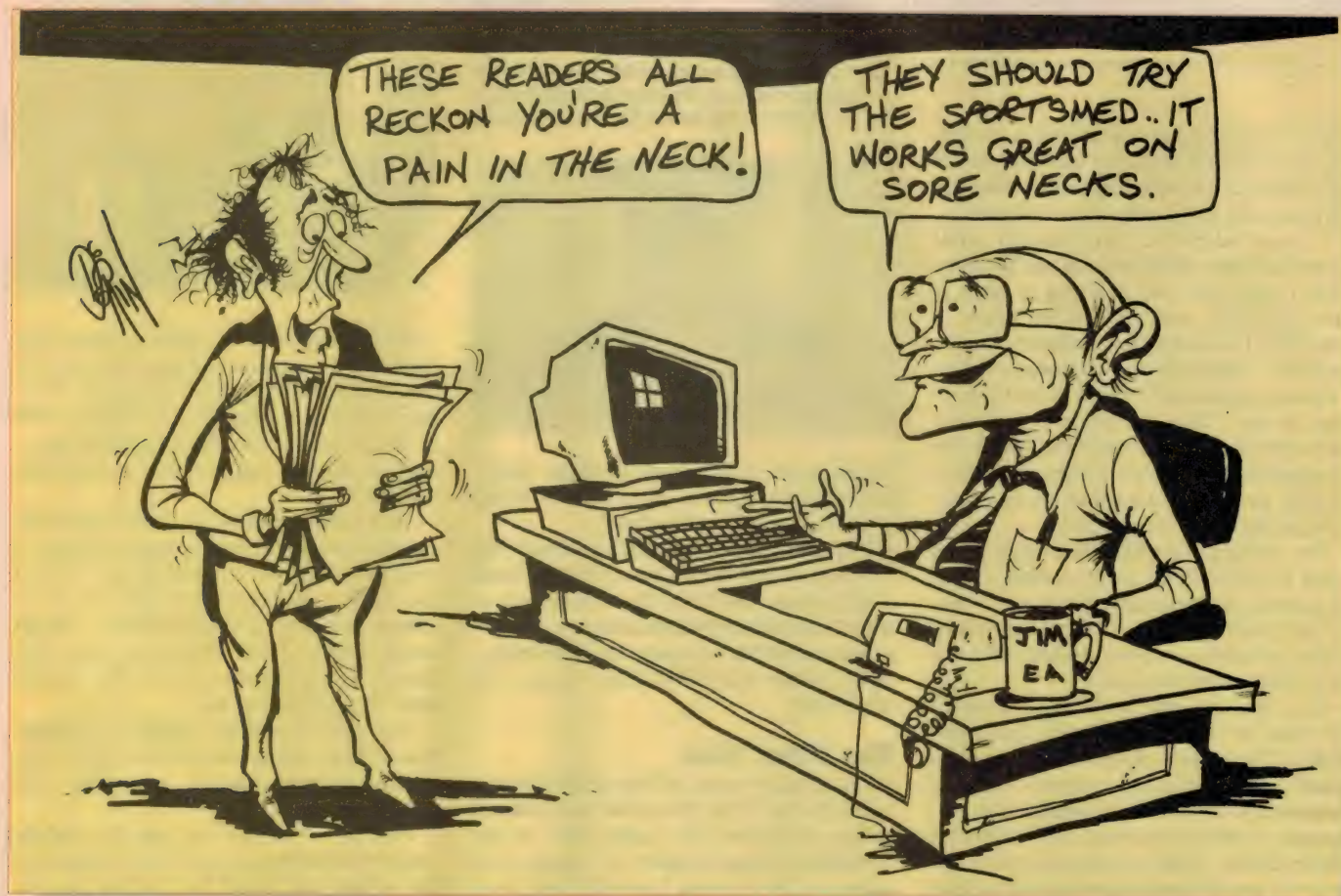
It is well known that the drug morphine relieves pain and produces euphoria, a feeling of peace and absence of distress. It is also well known that there are hormones that are formed naturally in our body which work in the same way. These are called 'endorphins' and 'enkephalins'. Morphine is an artificial clone of these hormones and would not work if it was not for endorphin reception regions in the brain.

The delivery of hormones and pharmaceuticals acting as clones of hormones act as inhibitors or transmitters to the passing of nerve impulses across synaptic junctions. The brain gradually releases these pain and stress relieving hormones when there is a pain.

When the TENS stimulates the sensory nerves, particularly at low frequencies, the brain reacts by releasing more of these hormones, to reinforce the pain relieving effect. When endorphins are released into the blood stream they act in a similar manner to some medications, by strongly blocking pain messages from crossing synaptic junctions in the CNS.

This is what is known as an 'endorphin effect'. It is similar to the 'second wind' that





runners experience after around 25 to 30 minutes running. In this time the levels of endorphins have built up to a sufficient level.

For a strong analgesic effect the TENS is used for several hours so that the amount of endorphins in the blood is built up and kept at a high level. Once you have stopped using the TENS, because the endorphins are in your blood stream they may relieve pain for anywhere between six and 36 hours until they have decreased to an insufficient level.

In the same way that medication will relieve pain up to a certain level, the endorphin effect will relieve pain up to a certain level. For stronger pain, the gating effect will in many cases give additional pain relief. The amount of pain relief achieved is different for individual people.

**The 'Gating Effect':** This theory of pain and its relief is largely the work of Professors Melzack and Wall. This theory is something along the lines that if a person stubs their toe, they find that rubbing it can make it less painful.

The pain messages predominantly travel along certain types of nerves called 'C-type' nerves. The TENS stimulates a different type of nerves, called 'A-type' nerves, to send non-painful messages along them to your CNS.

In your spinal cord these non-painful messages 'compete' with the painful messages in getting through to the brain. In many cases

the non-painful messages win. This means you feel the non-painful messages instead of the painful messages (remember 'rubbing the toe'). The TENS messages are seen by the body as being more important than the pain messages. This means the pain messages are blocked so the TENS messages can get through. The TENS messages have 'closed a gate' so that the pain messages cannot get through.

This gating effect is generally achieved with short periods of stimulation (less than one minute up to 15 minutes) from the TENS device, and this generally relieves pain for short periods.

So that seems to be the general idea: TNS promotes the release of endorphins which dull the sensation of pain, and also interferes with the transfer of pain impulses across synaptic junctions by producing 'competing' impulses which are somehow given a higher priority. (Which sounds a bit like the way acupuncture is supposed to work too, at least according to one explanation I've seen.)

### Precautions...

How about any potential problems with TNS — is it safe? Well, I found a list of 'contra indications' on the AECC web site, and many of the same cautions in the Bio Electronics literature. For example TNS is not recommended for people fitted with heart pacemakers, or who have epilepsy or a seri-

ous/unstable heart condition. It also seems to be considered unwise for use around the abdomen by pregnant women.

There's another warning that more or less applies to any technique of symptomatic pain relief: that by masking the pain, TNS may allow the real cause of the pain to go untreated, and hence result in it getting worse. Apart from that, the only other significant warning seems to be that prolonged use of the TNS electrodes applied to the same area of skin (for treating chronic lower back pain, for example) may cause skin irritation and inflammation. The simple remedy for this seems to be moving the electrodes around a bit, from time to time...

### How we found it

So much then for the basic theory — but how did we find the Bio Electronics Sportsmed unit, in practice?

Frankly we found it pretty impressive, although I should note that no-one in my immediate family is unlucky enough to suffer from serious chronic pain. That means that so far, we've only been able to try it out with a typical array of stiff necks, a sore shoulder (due to one of us losing our balance and falling against a wall) and a case of mild lower back strain.

My 'better half' gets a sore neck fairly often, for example, due mainly to stress and having to look downwards a lot. She has



## Forum...

found the Sportsmed quite helpful in alleviating the neck pain, reporting that a session of 20 minutes or so (while reading or watching TV) generally gives quite noticeable relief.

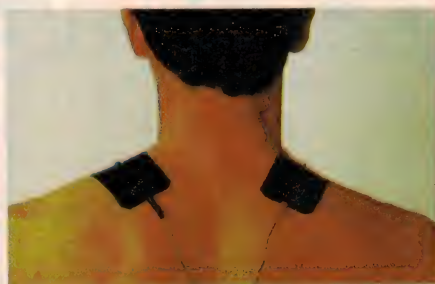
I found much the same myself, after returning from a short overseas trip last week with a sore neck due to trying to doze in uncomfortable positions on the plane. I found that I needed to have somewhat longer sessions — more like 45 - 50 minutes, before I noticed much relief, but this wasn't a problem. In fact I fitted the electrodes to either side of my lower neck, at the rear, slipped the Sportsmed into my shirt pocket, and had it pulsing away while seated at the computer writing part of a review article...

Our younger daughter also tried it out when she twisted her ankle recently during an exercise workout, and again found it beneficial. So for symptomatic treatment of mild aches and pains, we can certainly offer this kind of anecdotal 'thumbs up'.

How about the use of this type of device for relief of stress and anxiety symptoms, using CES (cranial electrotherapy stimulation)? As mentioned last month I was quite interested to try out the Sportsmed for this, because of the claims made for Dr Beck's 'Brain Tuner'. And as someone with a tendency to get somewhat stressed and anxious myself, I'm probably a good test subject.

Trevor Andrews of Bio Electronics kindly sent me a pair of ear-lobe electrodes to try the Sportsmed as a CES device, and so far I've tried it out on a couple of occasions when I've gone home especially tense and stressed out. It's hard to say how much effect these sessions have had, because stress symptoms are rather more intangible than pain; however I fancy that they've helped a

*Taken from one of Bio Electronics' brochures, these pictures show where the Sportsmed's electrodes are typically placed for TNS treatment of neck pain (below) and lower back pain (right).*



bit, at least. Apart from anything else I haven't had a migraine since I've been trying it out — so that's a good sign.

If you'd like to learn more about Bio Electronics and their Sportsmed and other TNS devices, you'll find them on the web at <http://www.bioelectronics.com.au>. They're located at 964 Mt Alexander Road, Essendon 3040; phone (03) 9870 6729, or fax (03) 9370 0619.

### The other side

I was going to round off this month by presenting a few of the letters that have come in taking me to task for 'going soft' on the alternative therapy brigade, but I seem to be running short of space. I probably only have space left for one short letter; the rest will have to wait until next time.

To give you an idea of the general tenor of these later missives, though, here's the email that arrived from reader John Harvey of Clermont in Queensland:

*What's this, Jim! Have you become an apologist for quacks and charlatans?*



*As I remember it, the devices which you dealt with in January were only ever likely to benefit the pockets of those who peddle them. Any therapeutic value to the victims would be all in their minds (there might be something in that too, but technically or morally sound it isn't).*

*Even handed and fair minded is one thing, but this reduces EA to a forum for ratbags — perhaps you might even rename your column the X-files. Knowing that you can never please everyone, if indeed anyone, you do really need to decide where your own allegiance lies. Personally, I'd take my chances with the sceptics any day...*

*The rules are dead simple — if these frauds can't validate their snake oil according to accepted scientific principles, then they get the flick.*

Hmmm — as you can see, Mr Harvey wasn't too impressed, and there were quite a few others who shared his reaction. An editor's lot is not a happy one, at times!

That's about all we have space for this month, though. Next time I'll try to present some of the comments that have come in from medical practitioners, offering their views about the devices we've looked at over the last six months. They make interesting reading, so I hope you'll join me. ♦

## EMP Modulator...

(Continued from page 19)

### Magic metal

If you still think Harmonic Products sound plausible, wait until you hear about the 'No Risk Disk', their other product. The Disk is a piece of purple anodised aluminium, available in different shapes and sizes. It does ill-described pseudoscientific metaphysical things, just like the EMPower Modulator. The Disk's basic intent is to protect you from harmful radiation, but it has various other pyramid power-esque abilities.

It would appear that when one wears the Disk, one can pass through airport metal detectors and not set them off — despite having a pocket full of spare change, a big metal belt buckle, a plate in one's head and a suit of chainmail on. But (and this is an important but) if one is attempting to do anything illegal, like smuggle guns, the Disk will cease to function and the detector will bleep.

Even if one believes one is doing something good when one really is not — if one is,

for example, a religious nut who believes one's god of choice is best served by blowing up this plane — the Disk still won't help you.

Naturally, the Disk will also make your beer taste better. And improve your gas mileage. And reduce tyre wear. And if you stick a weeny one on your mobile phone, you won't broil your head.

### Why this matters

The modern flood of 'miraculous' innovations has made it easy for questionable devices like the Modulator to pass, and be sold, relatively unnoticed. To the average consumer, a plug-in radiation eliminator may seem no more astounding than Global Positioning System receiver, or a supersonic fighter plane or a personal computer.

In the absence of effective governmental regulation of products based on nonsense science, I feel it to be the duty of those who can tell the difference to defend reason from the attacks of cynical hucksters and the innocently ignorant. If it's deemed all right to sell electronic snake oil, the more directly harmful old-fashioned kind will soon be back. ♦

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**\$14<sup>95</sup>**

**NEW**

### Rectifier diode

10A 600V stud mount, high current BYX98. Z 3243



**\$8<sup>95</sup>ea.**

**NEW**

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Simple tester great for checking circuits, leads and fuses for those broken tracks or wires. Q 1543

**\$7<sup>95</sup>**



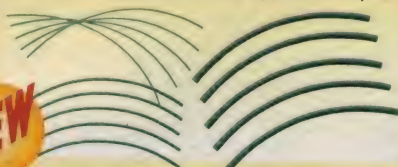
**NEW**

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Grade quality tubing that is highly flexible and radiation cross-linked. Shrinks to approximately 1/3 of the listed diameter. These black heat-shrink materials come in packs of five lengths by 200mm long.

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### Motorcycle intercom

- Provides 2-way communication for two riders on the one bike
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K 6021

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EA Jul '98

**NEW**

### '4 in 1' mini bench supply

- Easy to build DC power supply
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K 3213

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EA Jan '98

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- Use this updated wideband amplifier to boost signal strength
- Provides stable amplification of at least 9dB to 2GHz
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K 5801

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EA Jun '98

Includes power adaptor



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- Fade out from one image and into the next, or wipe-out from one image to another; either horizontally or vertically
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K 5415

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EA Apr '98



### High energy ignition kit

- Reduces the need for tune-ups in cars with points
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K 3303

**\$49<sup>95</sup>**

EA Jun '98



## velleman-kit

HIGH-Q



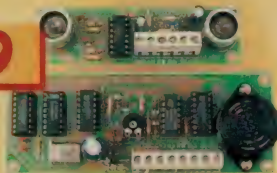
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### Parking Radar

- Emits ultrasonic soundwaves
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- Supply voltage: 10-15V DC/16mA

K 1303

**\$59**

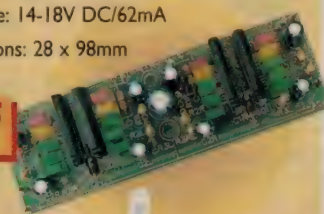


### Dual Stereo VU Meter

- Ideal for viewing or pre-setting all inputs of the mixer panel
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- Use with a 6 or 12 channel mixing panel
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- Relays on PCB
- Requires 12-15V DC

K 1305

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**Availability:** Our kits consist of many different parts from numerous suppliers. Whilst we have consulted closely with them and are satisfied as to their ability to supply, sometimes problems can arise in obtaining all of the parts. This means there is a slight chance that availability may be delayed. Rainchecks are available, however if you'd like to check beforehand, please don't hesitate to contact your local store.



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T 2920

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Includes Torx set, security Hex, Tri-wing, Hex and  
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H 1931

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\$10**



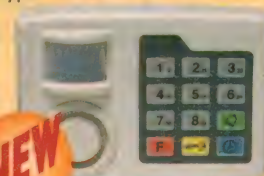
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GPS SYSTEMS

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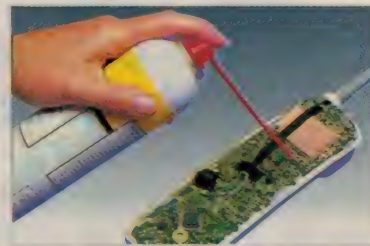


### DSE Air jet spray

Removes dust and lint from electrical equipment, computers and cameras.

N 1195

**\$14.50**

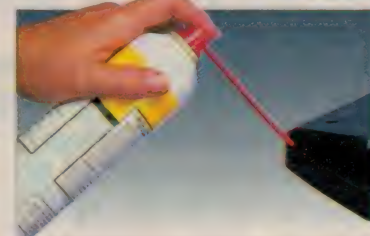


### DSE Contact cleaner

Great value – ideal for use on all electronics, PC boards, televisions, computers, keyboards, phones and CD players.

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**\$9.95**



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N 3114

**AF**

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# Serviceman

## The puzzling case of a PC system with a 'hardware virus'...



**One of our stories this month concerns a fairly elaborate PC system with a CD-ROM recorder or 'burner' and removable JAZ hard disk, which suddenly developed weird faults and finally turned out to have 'caught' what's best described as a hardware virus. There are also two tales of 'junk' equipment which was rescued from being consigned to the tip, by relatively easy repair jobs.**

**E**ven if you are not a computer buff, you must have heard of software viruses — those vicious little programs that can be extremely annoying, even if they're not downright destructive. Software viruses are written by anti-social characters who get their kicks from creating havoc in other people's computers. But have you ever heard of a *hardware virus*? These are different from the software species, since they are generally the result of spontaneous generation and not malicious acts by humans.

Fortunately, hardware viruses are very few and far between. But nevertheless, one of our contributors has run up against one and he's written his story for your information. The tale comes from George Katz, of Dee Why in New South Wales. Here's what George has to say...

A hardware virus? I didn't think it was possible either, until it happened to me and at a most inopportune time.

It all started with an external SCSI (Small Computer Serial Interface) CD-ROM 'burner'. I had been using the computer and burner at work for almost a year without problems, when one day I noticed that someone had disconnected the burner and a JAZ drive.

I reconnected the SCSI cables to both units and that's when the problems started. I turned on the computer and found that the CD-ROM burner was no longer recognised by the system. I checked the connections, but everything seemed to be in order. I pro-

ceeded to reboot the computer and again it had failed to see the burner.

The computer was fitted with a SCSI controller card, with one hard disk installed internally and the external CD-ROM connected via the port on the card. The external JAZ drive was daisy-chained through the CD-ROM burner by another SCSI cable. I checked all the connections again and power-cycled the computer, to find that now even the internal hard disk wasn't working. Or, at least, the SCSI drivers were not seeing it.

This was odd; so I disconnected the CD-ROM burner, thinking that it was faulty and causing problems on the SCSI bus. Sure enough after I disconnected the burner from the computer the hard disk was OK again. I breathed a sigh of relief at not having lost all my work...

Next I tried connecting only the JAZ drive to the computer. When I turned the computer back on, neither the hard disk nor the JAZ drive were recognized. It was unlikely that both the burner and JAZ drive were faulty, so again I breathed another sigh of relief, this time at not having a bad CD-ROM burner.

### The controller card?

Perhaps the SCSI controller card was faulty? I replaced it with an identical card, and again all the same symptoms of devices not being recognised occurred. That left me with one option: it must be the cable that connects the external devices with the SCSI card. This had to be it — I had replaced just about everything else.

Changing the SCSI cable for a brand new cable again met with the same results. This was becoming more intriguing than annoying.

At this stage I was beginning to suspect the internal cable from the SCSI card to the hard disk. So I replaced that, only to find the same problem again. Aha! I had it now, the only thing remaining was the SCSI terminator, right? Nope, it all checked out fine.

My system would only work with no external devices connected. I tried a brand new JAZ drive by itself, with the new SCSI cable I had used to replace the old one. Again the hard disk failed!

At that point I suspected a supernatural influence, and was debating whether to call the 'X-files'. I had replaced every-

thing I could, with the same problem always showing up.

I was ready to blame the poor motherboard, when I decided to take a closer look at the SCSI-2 cable connector. I am sure that many readers are aware that the SCSI-2 connector has a great many small pins, closely packed together. (Editor: I think they're often called the 'Honda' connector...)

At a first glance all looked well, but then one pin caught my eye. I noticed that it was leaning too close to the one next to it. Well, I was on the right track now. I straightened the pin and decided to check all the other cables. To my surprise the identical pins on all other connectors were bent the same way, even on the new cables I had tried.

Quickly dismissing the notion that this was 'As Designed' in the SCSI-2 specs, I checked the SCSI sockets on the CD-ROM burner and JAZ drive. I found that the corresponding hole for the bent pin was covered by the thin piece of plastic that normally separates each of the pins on the connector.

Now all became clear. One of the female sockets must have deformed when I first reconnected the CD-ROM burner. This forced two pins into the same hole and shorted them out.

Later when this cable was plugged into the JAZ drive, the pins, now bent to go into one hole, deformed the female connector on the JAZ drive, again pushing the separating plastic over the hole.

Plugging another good cable into this newly damaged socket caused the pins of the new cable to be forced together and short, and when this new cable was inserted into the good SCSI socket on the new JAZ drive it did more damage to that...

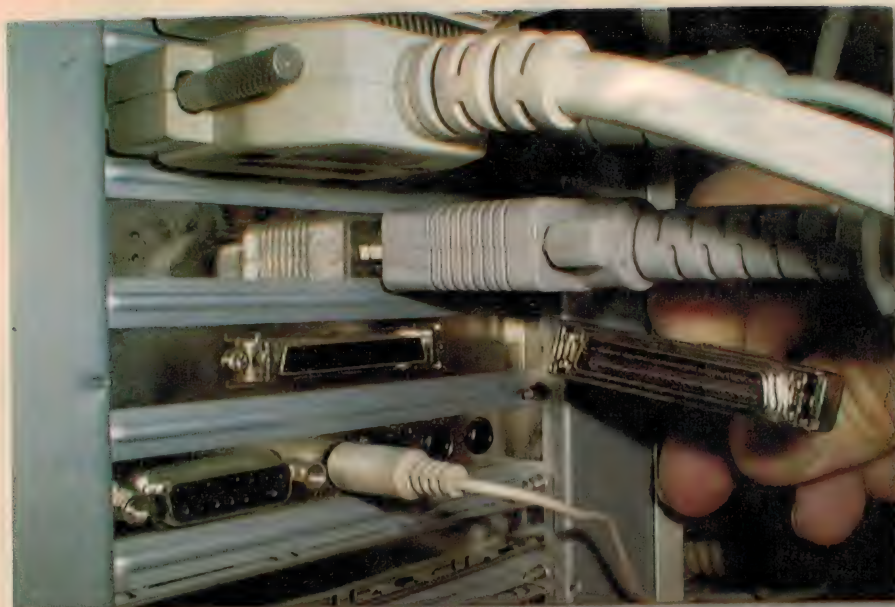
Before I knew it, I had four damaged sockets and three bad cables. The hardware virus had spread like a Sydney bushfire!

I am only glad the virus was contained and did not spread to the rest of the world! Can you imagine if this sort of thing happened in a big computer assembly plant?

Yes, George. I can imagine it. Bent pins and dinged sockets all over the place! I'm glad you chose to check that plug when you did. I can see you buying new cables in dozen lots, and new SCSI controller boards every week!

In fact, I've seen something similar in my own gear, but never to the extent that you





For those not familiar with the compact SCSI-2 'Honda' connectors, here's an example of a plug and socket. They're much smaller than the 57N50 SCSI connectors...

describe. I have a lot of trouble with the tiny pins in the mini-DIN plugs used for S-Video connections between my camera and video editor. I haven't damaged a socket yet — touch wood — but George's story shows just how easy it is to do.

Thanks for that tale, George. You might use your fee for the story to buy a spare cable. You might just need it one day!

Oh, and by the way — you didn't mention whether you were able to repair the sockets. It would be an expensive exercise if you had to replace the controller card and both drives as well as the cables!

### Young hobbyist

Now we have a short note from one of our younger contributors. Ralph Vitelli is a 12 year old reader from Geelong West in Victoria and he tells another tale of 'junque' that he was able to turn into a good working television. Here's what he has to say...

*I have been a hobbyist in electronics since I was four years old. I am now 12 and have just completed my first real repair job. It all started when my neighbour gave me an old TV, saying that the colour had failed.*

*It was a 45cm National Panacolor of unknown but fairly ancient vintage. I immediately put it on my workbench and plugged it in. I was greeted with a first class black and white picture. I tried the colour control, but it had no effect. I realized I could do nothing with the cover on, so off it came and I had a look inside.*

*At first it looked like the PCBs had been covered with a thick layer of cement, but then I realized that they were covered in a 1cm thick layer of dust. I quickly unplugged the set and took it outside to clean all this off. When I had another look, the problem was obvious. The auto-colour trimpot was nothing but a charred memory, and I had no*

*means of determining its original value.*

*I had a look in my junk box and all I found were a couple of 5k trimpots. I soldered one in place of the damaged pot — not expecting any miracles, mind you — but to my surprise the moment I applied power, a sharp, first class picture came onto the screen.*

*The only fault remaining was that the sound was crackly. I eventually tracked this down to a dirty volume pot.*

*My neighbour is still kicking herself, because that had been their only TV set and they had assumed that it was not worth the cost of repair. So, like so many other impatient people, they bought a new TV without even enquiring about the possible cost of repair.*

*So for only an hour of my time, I have got a great TV and the satisfaction of completing my first-ever serious repair job.*

*Thanks for a great magazine!*

Thank you for the compliments Ralph, and thanks also for an interesting little story. If you've been reading Serviceman for very long, you will have noticed that an alarming amount of worthwhile equipment is junked, while needing only a tiny repair or adjustment to restore it to full and proper order.

I think that new gear is becoming so cheap and people have so much spare cash that they have lost the will to retain their old stuff when it breaks down. I believe they don't even think about repair — it's just straight down to the High Street to get a new one.

But you needn't worry Ralph, because you've got a nice TV for your efforts, plus a few dollars for writing to us about it. Thanks again.

### "Not worth fixing"

Now we come to an interesting little story from my own bench. Or more particularly, from my own kitchen table. It really follows on from Ralph's tale, since it shows why

much good gear becomes 'junque'.

Last month our kitchen clock went crazy. It began running slow, and occasionally stopping for minutes at a time. I replaced the battery several times, but there was no improvement in its performance. In short, it was totally unreliable. My wife said "Get it fixed!" — so I did.

The clock was an analog style, driven by a 'Junghans' quartz movement and powered by a single AA cell. This brand has a reputation for good quality movements, so I felt that it should be repairable by any competent clockmaker.

The clock appeared to be *trying* to work, and I could hear the escapement clicking at a regular interval. I assumed that the fault was something like dirt in the works, and a watchmaker/jeweller should have been able to clean it and hopefully, get the clock working reliably again. But it wasn't going to be so easy.

I took the clock to the jeweller who has looked after my watches for years. He took one look at it and said that it wasn't worth fixing. (How often have you heard that one?) He claimed that the movement was unrepairable and a replacement would cost more than the clock was worth.

When asked how much a replacement would cost, I was told "about \$27!" I had to agree that the clock was worth hardly any more, so I decided to scrap it and get a new one, as soon as I could look into the prices and styles available.

Later that day I decided that if the clock was to be junked, I might as well find out what was inside it first. Rather than a sealed mechanism as implied by the jeweller, the case was held together by just two screws. I undid these and removed the cover, to reveal a tiny circuit board, an equally tiny solenoid, and several small nylon gears.

I could see the primary gear flicking as the solenoid was powered every second, but

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# Serviceman

it wasn't driving the secondary gear, although they were fully in mesh. It looked to me as though the electronics was simply not powerful enough to drive the gear train.

Either the gears were jammed by dirt or the like, or there was an electronic fault that reduced the drive power. I had already replaced the AA battery with a new alkaline cell, so I knew that it wasn't causing the trouble.

I lifted the primary gear out of mesh and found that the rest of the gear chain spun freely, without any sign of tightness or jamming. So it just had to be an electronic fault...

At this point, my fingers slipped and a second later, I was holding an empty case with eight tiny gear wheels spread across the table. More to the point, the circuit board was upside down in front of me — and the two battery terminals were lying somewhere else! In fact, those terminals proved to be the solution to the whole problem.

They were pressed out of light tinplate and were not soldered to the PCB. They made contact simply by pressure against pads on the circuit board. And neither the terminals nor the pads looked particularly clean. There seemed to be a very light coating of corrosion on the contact surfaces. The

clock had lived in the kitchen for 10 years or more, so it was probably steam and cooking gunk, etc.

I cleaned the contact area with a fine emery paper, then began the reassembly. Since I know next to nothing about clocks, it wasn't an easy job. The three shafts carrying the hour, minute and second hands were easy enough to identify, but two of them mount on one side of the assembly and the third on the other. But which?

Then there were five other gears that had to be assembled underneath — or was it in between? — the first group. Indeed, it was a very frustrating exercise, but eventually I found the right sequence and completed the job. From start to finish, it had taken about 20 minutes!

Of course, I still didn't know if it was going to work or not. But you will be pleased to learn that it did, and the clock is still keeping near-perfect time, several weeks later.

So much for the jeweller who couldn't fix a simple electronic clock mechanism! And so much for a \$27 replacement movement. I've just found the recent Jaycar catalog and they advertise an almost identical movement for \$10.95! Have these jewellers got so much work that they don't need new jobs? And what about customer satisfaction?

Now there's a new line for all you Servicemen — clock repairs. Some spares



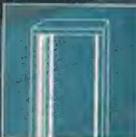
*The Junghans clock movement that's discussed by our Serviceman himself this month. The battery terminals are held in place only by the pressure of the circuit board and the cover securing screws. With only 1.5V to drive the clock, it only takes a loose screw or a spot of corrosion to stop it from working.*

might be difficult to obtain, but many jobs will only require a light scrape and perhaps a squirt of contact cleaner. And in the very worst case, \$11 will buy a 'drop-in' replacement!


That's it for this month. There'll be more from the service bench next time. ♦

# METALWORK


## Professional Installation Hardware



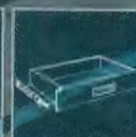
Racks



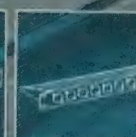
Wall Boxes




Plates




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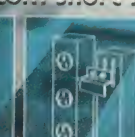
Patch Panels



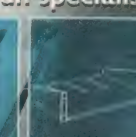
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# Circuit & Design Ideas

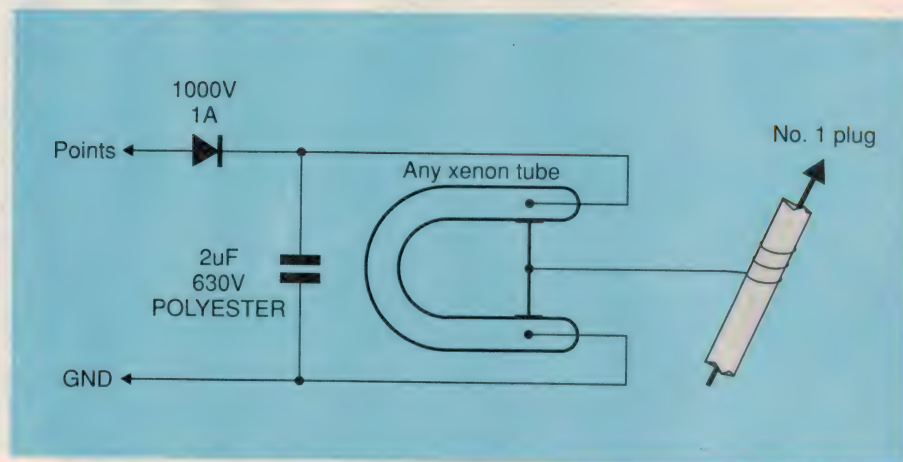
Interesting original circuit ideas and design tips from readers. While this material has been checked as far as possible for feasibility, the circuits have not been built and tested by us. We therefore cannot accept responsibility, enter into correspondence or provide any further information.

## Automotive timing light

The circuit is deceptively simple, but arose out of necessity. Let me explain... Some years ago, I urgently needed a timing light and didn't have time to build an inverter. Where was I to get the necessary high voltage? Well, I knew there was voltage of the right order available at the distributor points, so I used it!

There are only three components in this circuit, and the usual high voltage inverter is done away with altogether. This is achieved by using the back EMF from the ignition coil's primary to pump up the 2uF/630V polyester capacitor via the diode to around 300-400 volts.

The tube's trigger electrode is capacitively coupled to the No.1 spark plug lead by wrapping a short wire around it. This provides



sufficient trigger voltage to fire the tube.

The original prototype was built by taping the three components to a length of dowel,

and you're right, it hasn't changed since!  
John Symons  
Woodend, Vic. \$35

## IR intruder alarm

Low cost and using readily available components, this infra-red intruder alarm lets you monitor a door or hallway up to 2.5-3 metres across. The transmitter and receiver are installed 'face to face', on opposite sides of the door or hall, and if the modulated IR beam is broken between them, the alarm will sound.

The transmitter uses the well known 555 to pulse the IR LED at 1kHz, with the heavy current switching performed by Q1. While the peak current is quite high (around 800mA), the circuit's average current is quite low due to the low duty cycle.

The receiver consists of three main stages, the IR diode preamp, a switching circuit, and the alarm itself, based on another 555.

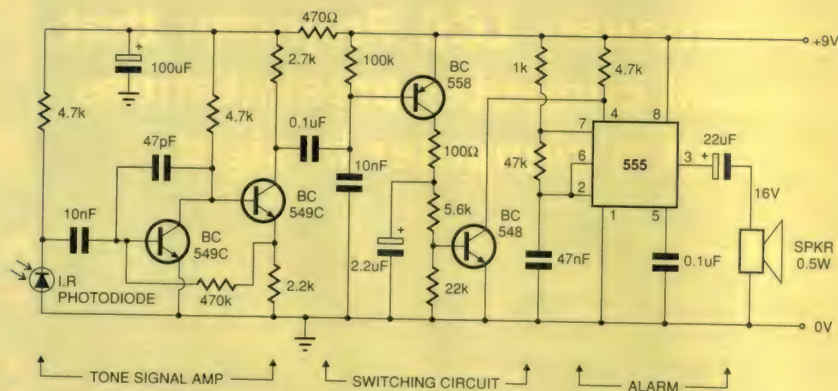
When the modulated IR signal is received, the signal is amplified and passes on to the switching section which holds pin 4 of the 555 low, keeping the alarm from sounding. If the beam is broken, the switching circuit turns off, and the 555 turns on producing an audio warning via the speaker.

The alarm can be used in reflected sunlight (not direct sunlight) or normal artificial light, as this is either not modulated or modulated at 100Hz respectively.

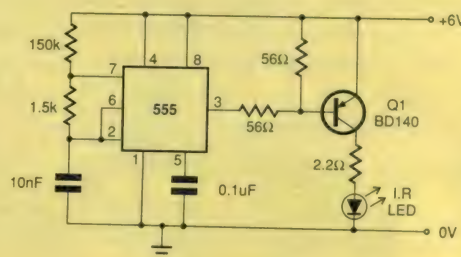
Pradeep G.

Alappuzha, S. India

\$40



Receiver



Transmitter



As an added incentive for readers to contribute interesting ideas to this column, the idea we judge most interesting each month now wins its contributor an exciting prize, in addition to the usual fee. The prize is a complete closed circuit TV system, comprising a 5" B&W video monitor, CCD video camera with stand, power supply and cabling. This system comes from our sponsor Allthings Sales & Services, and is valued at \$369.00!

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**'IDEA OF THE  
MONTH'  
Prize!**

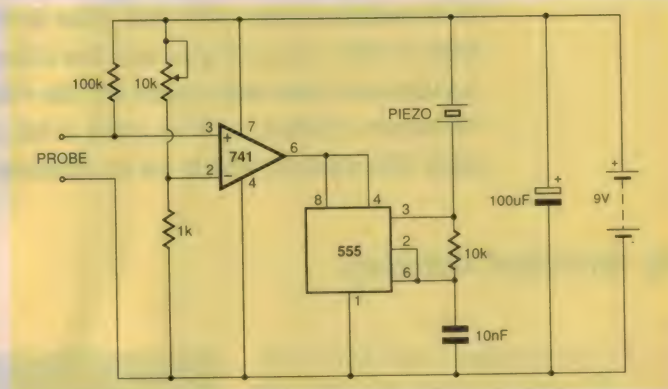
## Plant monitor

Here's a plant moisture monitor with an audible indicator. The simple circuit is powered by a 9V battery, and beeps when the water content of the soil is too low.

The moisture is measured through a positive voltage level detector, incorporating the LM741 op-amp. When the soil becomes dry, the voltage on the positive input rises, and as it exceeds the voltage on IC2's negative input, then the op-amp's output swings high. This powers the 555 timer IC, which oscillates and drives the piezo — alerting you that the soil is dry.

The moisture sensitivity is adjustable via the 10k trimpot, and the circuit draws around 1-2mA.

Lower current drain can be achieved by using the TLC251 low power op-amp IC, and the CMOS version of the 555, the TLC7555. You could also try increasing the 10k pot and 1k resistor to 100k and 10k respectively.



Anton Makotter, Plymton Park, SA

\$30

## AM re-transmitter

With nearly all the AM stations moving up to the FM band, I had the need to re-transmit some of the FM stations on to the AM band. Why? Because I am a valve radio enthusiast, and just about all domestic valve radios only receive AM. The circuit is designed around an oscillator coil scavenged from an old AM radio, although it must be the one with the *red* slug. This coil sets the frequency with the associated tuning capacitor (150pF) across its secondary. By changing this value the output frequency can be changed but you'll probably

find that the coil slug gives enough range.

I found that the re-transmitter must be run at a low voltage, otherwise the oscillator is swamped and distorts. To use it, simply tune the coil to transmit on an unused portion of the band and tune the radio to that frequency. The earphone or headphone output from a portable FM radio is used for the audio modulation, and by using the volume control on the FM radio you can regulate the amount of amplitude modulation in the output of the circuit.

The power output from the circuit is very low, so the antenna of the AM radio has to be in very close proximity to the transmitting

antenna; I used an old telescopic antenna (from the same radio I scrapped for the coil), and wrapping a couple of turns of the valve radio's antenna around the telescopic was enough.

An added bonus with this circuit is that you can connect it up to a CD or record player, and transmit music appropriate to the era of the vintage radio concerned!

Colin Leonelli

Allingham, Qld. \$40 ♦

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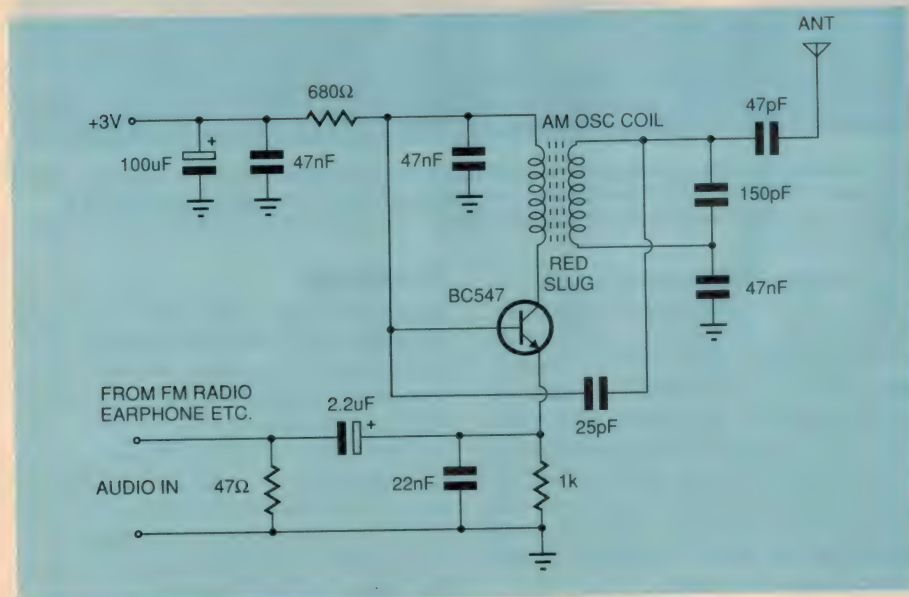
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# MOTORCYCLE INTERCOM

If you've ever ridden as a pillion passenger on a motorcycle, you'll know just how hard it is to communicate with the rider in front of you — other than with a jab in the kidneys that is! It's worse if you are the rider in front, as you have to keep both hands on the handlebars, and both eyes on the road. The answer to such hassles is some kind of intercom system, and so after a lot of prodding from bike-riding readers, we came up with this design, which we've dubbed the Bikecom.

by **Graham Cattley**

**W**e last presented a motorcycle intercom over 14 years ago, and were quite pleased with its popularity. Time moves on, however, and the original design was showing its age, with the main quad op-amp (an LM4136) becoming unavailable. It also used a pair of four-transistor amplifiers that were sometimes a bit troublesome to set up, and so we felt that a complete re-design was in order.

This new design is simpler and cheaper to build, and offers more features than the original design — and more even than comparably priced commercial units. A quick rundown of these extra features includes battery operation (with the option to run the unit off the bike's main battery if preferred), very rugged construction, a case small enough to slip in a jacket pocket, and full duplex operation with a single volume control for both channels.

On top of all this, the Bikecom doesn't mix the two channels together; this makes for a less noisy system, as the noise from your own microphone isn't superimposed on the signal from the other rider. A couple of other points, including automatic turnoff when you leave the motorbike (i.e. no on/off switch), make the new project a very practical proposition if you take passengers riding pillion, or even in a side car.

## Filtering

The main reason you need an intercom on a motorbike is that riding down a highway at 100kph is a very noisy experience. Most of this noise is at fairly low frequencies, being due mainly to wind blowing past the helmet, and of course that 500cc or bigger power plant growling underneath you. Most of this can be conveniently removed by filtering out everything below 500Hz or so, and so this design includes both high-pass and low-pass filtering to pass



*The Bikecom: A cheap, simple way to communicate between rider and passenger, and it's easy to build as well. You can see here the plug/socket connection between the Bikecom and each helmet, as well as the clip for each of the boom mikes we used with the prototype.*

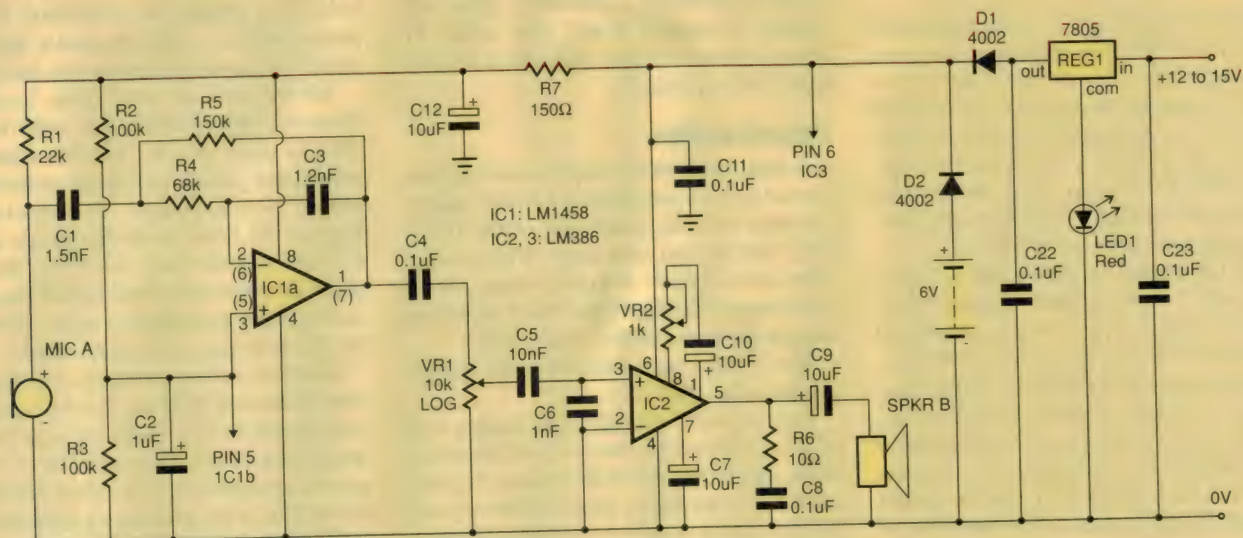
only frequencies between 600Hz to 3kHz.

There is a fairly steep roll off on the high-pass filter, at -18dB/octave, which when combined with the -6dB/octave low-pass filtering results in a reasonable attenuation of everything outside the human voice spectrum. A further degree of high-pass filtering is added by the relatively small value of the audio amplifier's output capacitor, but the break point of this extra -6dB filter will depend on the actual impedance of the speaker used in the helmet.

## The circuit

The circuit in Fig.1 shows only one channel of the Bikecom, as the other channel is practically identical (except for the supply decoupling components R7/C12, the voltage divider R2/R3, and of course the power supply section.) The signal from the microphone is AC coupled by C1, and then fed into the audio filter based around IC1a. IC1 is an LM1458 dual op-amp, not particularly known for its low noise characteristics but in this decidedly Lo-Fi application it doesn't





really matter, so in this circuit I used it to take advantage of its low voltage operation.

R4, R5, and C3 tailor the frequency response of the filter to give a bandpass of 600Hz to 3kHz, while resistors R2 and R3 provide the half-rail bias for both channels with C2 bypassing the positive inputs of both IC1a and IC1b.

As it stands, the filter exhibits a frequency response of 600Hz to 2.2kHz, with an attenuation of 1.5dB. The effect of the coupling capacitors C4 and C5, along with VR1 and the 50k input impedance of IC2 increases the low-end rolloff, while the overall signal level is attenuated by 3dB. While this is pretty severe, the resulting signal on the positive input of IC2 is more than enough to drive the amplifier fully.

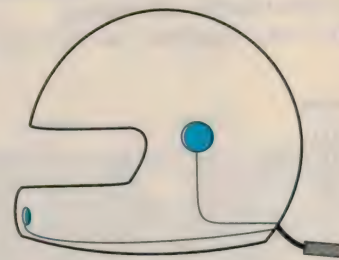
Each channel uses a separate LM386 power amplifier, with the gain adjustable by VR1/VR2 up to a maximum of 200 for each channel. This adjustment lets each rider preset their amplifier to suit — the rider in front will probably encounter more wind noise and hence require a higher volume, or one rider may have an 'open face' helmet which will not be as effective in blocking out external sounds.

Capacitor C6, along with C8 and R6 provide stability, while C7 and C11 decouple the amplifier's supply rails. The combination of R7 and C12 help to decouple the front ends of each channel, preventing feedback via the supply rails.

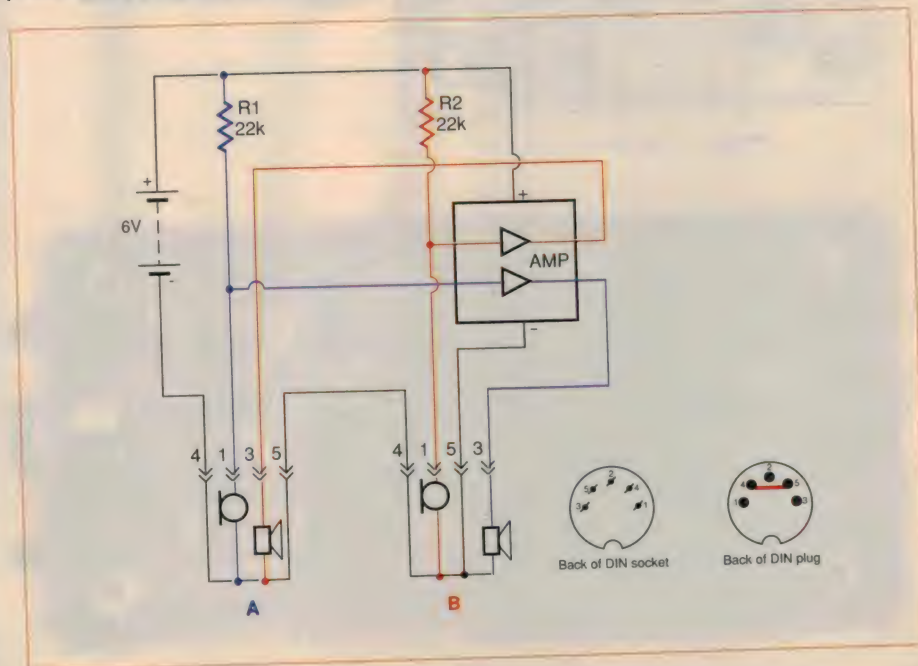
Speaking of supply rails, the Bikecom is designed to be powered either from a set of four penlight (AA) batteries, or from the motorcycle itself. There's nothing special about the battery power arrangement, with D2 preventing damage to the unit in case the batteries get connected in reverse.

To power the Bikecom from the bike's own 12V lead-acid battery calls for a little

more circuitry, though. In order to prevent the various whines, clicks and other assorted noises from the bike's 12V supply from getting through to the Bikecom's sensitive front end, we use a simple voltage regulator to provide a degree of isolation. The nominal 12V supply is cut down to 6V by REG1, a 5V voltage regulator with LED1 in its common lead. The 1.5V drop across the LED jacks up the regulator to somewhere around 6-7V, which then powers the circuit via D1.



**Fig.1 (top), shows the circuit for one channel of the Bikecom. The filter based around IC1 gives a band pass of 600Hz to 3kHz, with the resulting signal amplified by IC2. Fig.3: (above, right) is the general arrangement for wiring up a microphone and pair of speakers inside the helmet. The DIN plug should be wired on a short length of cable secured to the helmet. Fig.2 (below) illustrates the switching arrangement, with the power to the circuit cut if a helmet is unplugged.**





## Switching

I mentioned earlier that the Bikecom doesn't have an on/off switch and that is, I suppose, only partly true. Power switching is performed by routing the negative rail from the battery or power supply up to the first helmet, through a shorting link in the DIN connector, back down again, along and up to the other helmet, through a second shorting link, and finally back down to the circuit.

If all this sounds confusing take a look at Fig.2, which shows a block diagram of the power switching system. As you can see, the main circuit will only be powered if both helmets are plugged in. Remove one and the negative rail is broken, switching off the circuit.

What's that, I hear you say? Unplug helmet B and Helmet A's microphone is still powered? Yes, well, I didn't say that the system was perfect, did I... Due to the limitation of only four lines in the helmet cable I couldn't get around this, but as the microphone current is in the order of only a few microamps, it won't affect the life of the battery.

Fig.2 also highlights the fact that the

microphones and speakers 'cross over'. That is, the microphone in helmet A drives the speaker in helmet B and *vice versa*. An obvious point perhaps, but one that could easily be overlooked...

## Construction

The Bikecom is fairly simple to put together, but for ease of construction I would suggest you start with the installation of the 18 PC pins, and the two wire links. With these in place, you can move on to the resistors, diodes and trimpots, followed by the MKT capacitors and the single monolithic capacitor C11.

The IC's are next, followed by the voltage regulator and the LED.

Drill a couple of holes in the bottom half of the case to accept the two 3mm mounting bolts, and mount the PCB securely in place as shown in the photo. Be sure to leave room for the battery holder. I used some double-sided foam tape to keep the battery holder in position, as mounting bolts tend to get in the way of the individual cells.

Three holes will need to be drilled in one end panel — two for the helmet cables and one for

the volume control. The placement of these holes isn't critical, but make sure that you arrange things so that the cables don't foul against the support pillars when the lid is put on.

Tin the ends of two 45mm lengths of three-way ribbon cable, and solder them to the two gangs of VR1. Put this aside for a minute and you can get started on the helmet cables. We made one of the cables twice as long as the other, with the shorter around 650mm, and the long one 1.2m. Strip off about 20mm of outer sleeving off the end of each of them, and tighten a large nylon cable tie 10mm further up the outer sleeve.

Insert two rubber grommets into the cable entry holes you drilled in the end panel, and then thread the two cables through them. A quick look at the photo will show you the general arrangement. One point I might mention is that in the prototype I used four-core individually shielded cable, but there isn't any reason why the cheaper figure-eight twin shielded couldn't be used. In fact you can use any cable you like, with the only criteria that there are four separate conductors, and that at least one of these is shielded.

With the cable I used, I connected the four separate lines to the pins on the PC board, and connected the shield to one of the ground connections up in the DIN socket.

A pair of inline DIN sockets will need to be soldered on to the free ends of the two cables, and pay close attention to the pin numbering in Fig.2 to prevent mis-wiring. Both channels are wired identically, with the microphone line labeled 1 on the PC board connecting to pin 1 on the line socket. The same goes for the speaker connection — pin 3 on the PCB goes to pin 3 on the socket. The two ground connections go to pins 4 and 5 as marked on the board, and you'll note that nothing connects to pin 2 on the DIN socket.

With the bulk of the wiring out of the way, you can now connect the flying leads on the pot to their respective pins on the board, and then wire up the DC socket and mount it in a convenient spot on the rear panel.

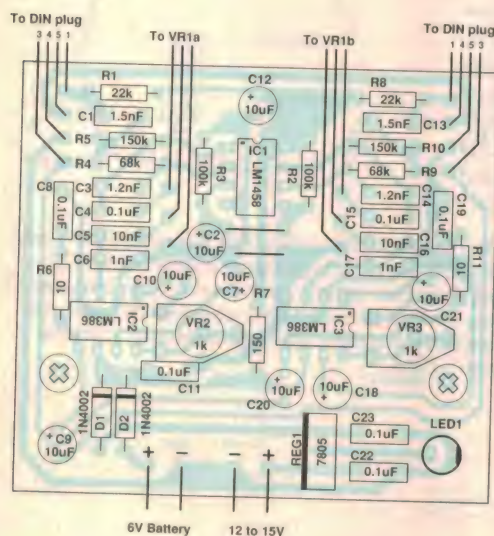
## Testing

Before you go any further, it's probably a good time to test the circuit so far, and in particular the power supply and switching.

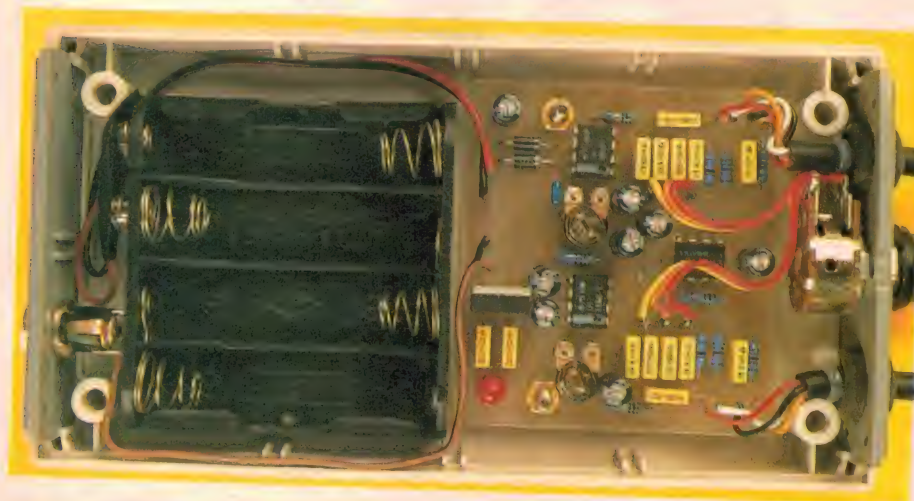
With the batteries removed, connect a 12V power supply to the DC power socket, check that there is around 6.5V between the anode of D1 and the negative battery pin on the PC board. The red LED should be glowing and there should be zero volts between the battery terminals.

If all's well, make up two shorting links by soldering a short length of tinned copper wire across pins 4, 2 and 5 on the rear of each of the DIN plugs.

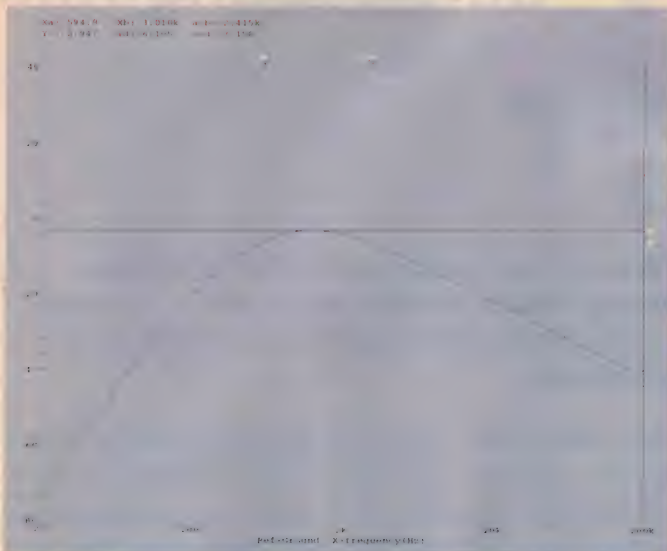
Measure the current drain of the circuit with the power supply running and the LED



**Overlay diagram and photo:**  
At left is the parts overlay diagram. Watch the orientation of the eight 10uF electrolytic capacitors and the two diodes, and use a monolithic capacitor for C11. You can see from the photo below that the board is mounted in the case with a pair of 3mm countersunk bolts. Also note the nylon clamps used to prevent the cables from pulling out, and the wiring to the volume control.

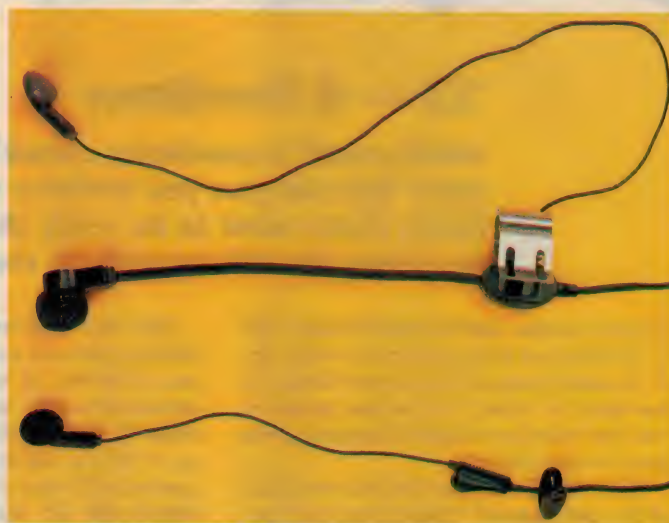






The frequency response of the active filter, showing the bandpass response from 600Hz to 3kHz. The high pass roll off is -18dB, which cuts out a significant amount of wind and motor noise.

At top is a boom mike left over from a old commercial unit, while below it is a readily available hands free headset used for mobile phones. The microphone is mounted in the pear shaped molding, just to the left of the spring clip.



glowing, and it should be somewhere in the region of 5mA. Insert the two shorting plugs and this should rise to around 15mA with the rest of the circuit powered.

While you are at it, you can drop the supply voltage down to 6V, and connect it across the terminals of the (empty) battery holder. The LED won't light, but you should get around 10mA current drain with both plugs inserted.

## Helmet wiring

I'm not going to be too specific about wiring the microphone and speaker into the headphone, as the details will vary from person to person, and helmet to helmet.

Also, there are different options available depending on whether you have an open or closed face helmet, and whether you want to have a permanent or removable setup.

For the photo at the beginning of this article we used a special-purpose boom mike with attached single earphone, wired up to a 3.5mm stereo plug. This is by far the easiest solution as you need only clip it onto the side of the

helmet, and re-terminate the lead with a DIN plug. You may well already have a couple of these left over from a previous intercom unit as we did, and apart from the frailness of the earphone lead they were quite satisfactory.

Another simple and removable setup involves the use of a hands-free microphone/earphone designed for use with mobile phones. The microphone can be clipped into the lining of the helmet, with the lead tucked into the lining and again terminated with a DIN plug.

With both of these systems, the single in-ear style earphone is on a long enough lead to allow you to comfortably position it in your ear before donning the helmet. Oh, and if you prefer, there is nothing stopping you from making up an adapter converting the DIN plug to a 3.5mm socket, letting you easily replace the headset at a moment's notice, without having to rewire anything.

A more permanent system involves gluing microphone and speakers inside the helmet, with the cable to the DIN plug protruding from the back of the helmet. Fig.3 shows the general arrangement, but you'll obviously want to adapt this to suit your own requirements.

A standard electret microphone insert can be glued to the inside of the helmet, with the active surface aimed towards the mouth to reduce the amount of noise picked up from outside.

Electret microphones the size of a match head are available as part of mobile phone headsets; these are ideal in this application, as they can be tucked

out of the way in the front of the helmet. The speakers can be taken from an old pair of headphones; these will usually incorporate some sort of protective grille over the diaphragm which should prevent damage.

As a last suggestion, don't forget Velcro — it's an easy way to make a semi-permanent arrangement for mounting the microphone and speakers inside the helmet, and only costs a few dollars extra. ♦

## PARTS LIST

### Resistors

(All 5%, 0.25W)

R1,8	22k
R2,3	100k
R4,9	68k
R5,10	150k
R6,11	10 ohms
R7	150 ohms
VR2,3	1k horiz. mini trimpot

### Capacitors

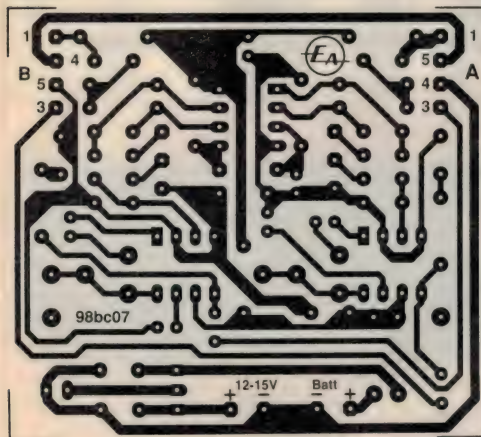
C1,13	1.5nF MKT
C2,7,9,10,12,18	
20,21	10uF 16VW electrolytic
C3,14	1.2nF MKT
C4,8,15	
19,22,23	0.1uF MKT
C11	0.1uF monolithic bypass
C5,16	10nF MKT
C6,17	1nF MKT

### Semiconductors

IC1	LM1458 dual op-amp
IC2,3	LM386 audio power amp
LED1	5mm red LED
D1,2	1N4002 silicon power diodes

### Miscellaneous

PCB 64 x 64mm, coded 98bc07; Plastic case 150 x 77 x 30mm; 4 x 1 AA battery holder; 2.1mm panel mount DC socket; 10k dual-gang 17mm log pot; 2m of 4-core shielded (or twin shielded) cable; 2 x 5-pin DIN plugs; 2 x 5-pin DIN sockets; microphones and speakers to suit; nylon ties, mounting hardware, hookup wire, etc.



The Bikecom's PCB artwork is shown here actual size. Due to the small size of the box front, there is no front panel artwork.



# \$10 Wonders

## 13 — A Two-timer

**What's this? A two-timing circuit? Well no, not quite. It is in fact a simple timer that will give you advance warning that it is about to go off — it's very handy if you need to be ready the moment the timed period has expired, or for things like timing calls on the telephone.**

**T**his is a timer with the useful feature that it warns you when your time is *nearly* up.

In other words, it is a two-level timer, or two-timer for short. You set the period of time you want (up to about 10 minutes), then press the reset button.

The timer is silent for the first two-thirds of the timed period. Then for the last one-third of the period, its buzzer emits a 'beep-beep, beep-beep' signal (or you can substitute a lamp which gives repeated double flashes). This is to warn you that the time is nearly expired. When the time is finally up the buzzer changes to long single beeps with a short pause between them. At any stage you can press the button to reset the timer to begin again.

### How it works

To keep costs down to the ten-dollar target, we forego the usual 555 timer IC and instead use the square-wave oscillator which is already built into the CMOS 4060 14-stage counter/divider. This is accurate enough for most purposes, but its main disadvantage is that it runs more slowly if the battery is flat. The period of the oscillator is  $2.2RC$ , where  $R$  is the value of  $R1$  plus  $VR1$  and  $C$  is the value of  $C1$ , as shown in Fig.1.

Trimpot  $VR1$  is provided for adjusting the frequency from 20Hz up to 440Hz. The corresponding periods for these frequencies are 50ms to 2.3ms (0.05s to 0.0023s).

This clock oscillator signal is fed into the divider chain and we next see it at the outputs of the 4th, 5th and 6th stages. At these outputs the periods are 16, 32 and 64 times longer than that of the oscillator. For example, if  $VR1$  is adjusted to give a signal with a period of 24.4ms (0.0244s), the signals at outputs  $Q4$ ,  $Q5$  and  $Q6$  have periods of 0.39s, 0.78s and 1.56s respectively. These are used to turn the buzzer on for short periods to produce the beep-beep and long-beep signals. The reason why we have chosen these rather peculiar figures for the example will become clear later (I hope!).

At the end of the dividing chain we have outputs  $Q13$  and  $Q14$ , whose periods are 8192 and 16,384 times longer than the oscillator period, respectively. For a clock signal with period 0.0244s, the outputs at stages 13 and 14 will therefore have periods of almost 200 and 400 seconds respectively, as shown in Fig.2.

While output  $Q14$  is low, there is no sound from the buzzer. This is the silent phase. After 200 seconds, output 14 goes high but 13 is low, and the beep-beep phase begins. Another 100 seconds after that (which is five minutes from the start), both outputs are high and the sound changes to long beeps. So the timer can be adjusted to time a period of five minutes by setting its oscillator to have a period of 0.0244s. Other timings can be set

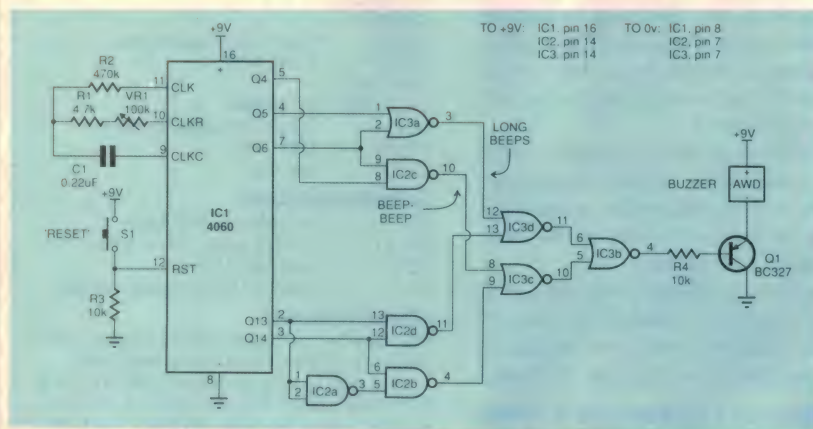
by using the formula  $t = 12300 \times P$ , where  $t$  is the time to the start of the long beeps phase and  $P$  is the oscillator period. The full range of oscillator periods makes it possible to set this timer to any time between about half a minute and 10 minutes.

The output from the logic circuit at IC3, pin 4, is normally high and swings low when the buzzer is to sound. This is why we use a PNP transistor instead of the more usual NPN transistor. A low input to its base turns the transistor ON, which in turn switches on the buzzer.

### Logic simulation

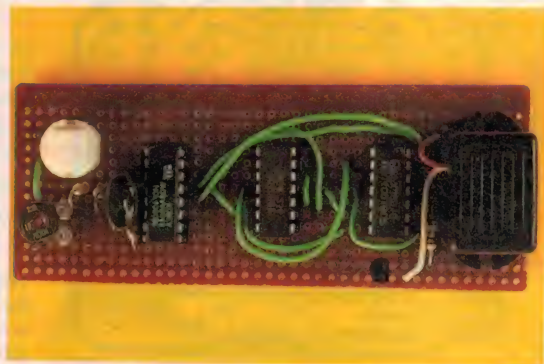
Some readers will be interested to see how this circuit was designed using a logic simulator. I used *B<sup>2</sup> Logic 3.0*, and the B-squared stands for Beige Bag Software, of Ann Arbor, Michigan. The version I used has no 14-stage divider, but it is easy to build up a 12-stage divider by cascading three 4-stage dividers, and this then corresponds to stages 3 to 14 of our 4060. The dividers are actually based on the 7493 TTL logic ICs, which each contain a 1-stage and a 3-stage divider. The input is fed to stage 1 and the output of stage 1 is fed to the input of the 3-stage divider.

For working out the switching logic there is no point in simulating the oscillator. Instead, we just pick out a ready-made clock module from the program's library, and feed its output to the first divider. The clock can



**Fig.1:** To keep the cost down, we've used a 4060, a binary counter with a built-in clock. The timer's outputs are decoded by IC2 and IC3 which drives Q1.

**Reasonably compact, this timer can be preset to the required time and mounted in a small box. An on/off switch would be a good idea as well, as the circuit simply re-starts when the button is pressed.**





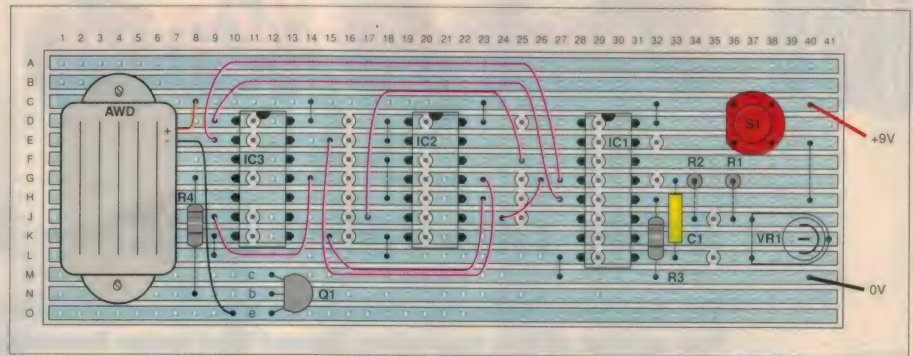
*There are a fair few jumper wires in this project, double check their placement carefully with this diagram. If you want to make the timing period easily adjustable, you can replace VR1 with a 100k panel mount potentiometer.*

be set to run a lot faster in the simulation (something like 100MHz!) to speed everything up, but as the logical sequence is the same, it doesn't make any difference. The outputs from the first divider provide the switching signals. By feeding the outputs of stages 5 and 6 to a NOR gate we obtain the switching for the long-beep signal. To see what this looks like, we select a probe from the program's device box and connect it to the output of the NOR gate. Then we can run the simulation and see its results plotted at the bottom of the screen.

The switching signal for the beep-beep phase is obtained by NANDing outputs from stages 4 and 6, and as expected, this gives two low-going pulses in rapid succession followed by a longer pause. What is not expected is the additional very short pulse just before each pair of pulses. This is a glitch is due to delays in the dividing chain (we are using ripple dividers in the simulation and the 4060 too is a ripple divider). In some projects this glitch could mean big trouble, but the length of the glitch depends on the timing of the actions of the divider. It will be no longer when the clock runs more slowly, and an unintended beep of a few nanoseconds will not be heard.

While stage 14 is low, the switching signals are being produced but the outputs of gates 2b and 2d remain high so the buzzer is silent. Eventually, at the beginning of the beep-beep phase, stage 14 goes high, and stage 13 is low. Gate 2b goes low and this allows the beep-beep signal to pass through gates 3c and 3b to the transistor. The buzzer is switched on as the beep-beep signal goes low.

At the final stage of the cycle, the long-beeps phase, stages 13 and 14 are both high, gate 2b goes high again, while gate 2d goes



low. The beep-beep signal is disabled at gate 3c, but the long beep signal can now pass through gates 3d and 3b to the transistor.

## Construction

There are lots of connections between the gates, but many of these are made by using the copper strips of the stripboard, either to join pins on opposite sides of the ICs or between one IC and the next. Take great care to cut the strips where indicated and not at other places. This leaves just a few wired connections to complete the circuit.

Assemble IC1 and its associated components first. When power is applied, monitor the output from the early stages (pins 4, 5 and 7) using a multimeter or oscilloscope. Outputs swing strongly between 0V and 9V at varying rates. You will have to wait several minutes to check changes at the later stages (pins 2 and 3). All outputs will fall to zero when the reset button is held down. If the divider fails to go through the proper sequence, check for unintended short-circuits between outputs (including all the unused ones) due to solder blobs or fine hairs of solder.

Next assemble the logic circuits, IC2 and IC3. Then monitor the output at pin 4 of IC3, first having adjusted VR1 to obtain a fairly rapid clock rate. The output is high after resetting but later pulses low according to the sequence of switching signals. If

the output of pin 4 seems to be correct, proceed to assemble the transistor and AWD (buzzer). If the signals are not correct, monitor the outputs of all the gates, following the switching signals through from gates 2c and 3a, then to 3c and 3d, and finally to gate 3b. Then monitor gates 2a, 2b and 2d. Note that gate 2a is connected as an inverting gate, its inputs being joined by a blob of solder. When its inputs are low its output is high, and vice versa.

The two-timer has an obvious application as a telephone call timer, to warn you when it is time to start saying goodbye. But not many people want a loud beep-beep as a background to their fond farewells. In this case you can substitute an LED for the buzzer. Alternatively, fit a 6V/60mA filament lamp, omitting the resistor R5 and reducing R4 to 100Ω. ♦

## Parts List

### Resistors

(all 5%, 0.25W)

R1	4.7k
R2	470k
R3, R4	10k
VR1	100k horiz. trimpot

### Capacitors

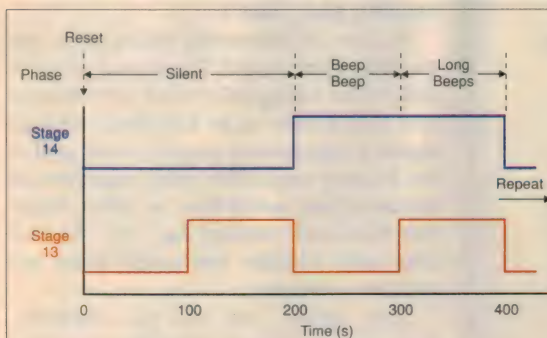
C1	0.22uF polyester or MKT
----	-------------------------

### Semiconductors

IC1	4060 14-stage binary counter
IC2	4011 quad 2-input NAND gate
IC3	4001 quad 2-input NOR gate
Q1	BC327 PNP transistor

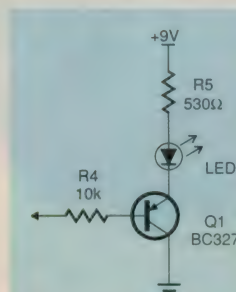
### Miscellaneous

Single-pole momentary pushbutton, PCB mounting; 6-12V buzzer; Stripboard 36 x 107mm (14 strips x 41 holes); 2 x PC pins; 16-pin IC socket; 2 x 14-pin IC sockets. B<sup>2</sup> Logic 3.0 is an inexpensive logic simulation package published by Beige Bag Software, 1756 Plymouth Road, Ann Arbor, Michigan 48105. e-mail: info@beigebag.com or 71620.3474@compuserve.com.



**Fig.2:** You can see from this diagram that the alarm will only sound while Q14 is high. If Q13 is low you'll get the beep-beep- warning, and once it goes high you'll get the final alarm sound.

*If you want to drive an LED instead of a buzzer, here's how to hook it up to Q1 by using a 470Ω to 1k dropper resistor.*







# Vintage Radio

## Early two valve sets — 1922 to 1926

**The one valve radio was able to be used in many ways, as we've seen in earlier articles. The advent of the two-valver meant that under favourable conditions, loudspeaker reception was possible.**

**T**It can be argued that the one-valve radio belonged to the tinkerers and hobbyists, while the two-valver belonged to the serious enthusiast. In those very early days, a two valver would cost twice as much to purchase the parts, be more complicated by a factor of at least two, take twice as long to build and cost twice as much to operate!

When we think of two valve radios, probably the first thing that may come to one's mind is a radio of two triodes, consisting of a regenerative detector transformer coupled to an audio stage — which, depending upon location, valve types and transmission power, might indeed operate a sensitive loudspeaker. However a two-valve 'radio' equally capable of working a loudspeaker

might consist of a well designed crystal set followed by a two stage audio amplifier. The circuit printed in this column for October 1996 showed just such a circuit.

Overseas, particularly in England and the United States, the big boys were already well under way with their selection of two valve designs. Indeed, the Gec-O-phone BC 2001 referred to in October 96 column mentioned above appeared on the English market in 1922. The circuit for this peculiar circuit is shown in Fig. 1.

Here we see a choice for the antenna connection; either via the 200pF capacitor, or direct into the first tuning stage. The socket marked 'loading coil' is for an additional inductance which is placed in series with

the variometer, so that the set could tune down to the long wave band — typically about 200kHz to about 500kHz. The socket connections were for a long or short antenna, as appropriate.

Following the circuit, we see that the RF amplifier is anode tuned via the 200pF ('0.0002mfd') variable capacitor (not shown as such in the circuit) and the bottom coil of the 'reactance unit'. This curious little device is a moulded bakelite former which looks not unlike one of a pair of castanets. It is hinged at the bottom, and the amount of coupling and hence feedback is adjusted by hand. The de-tuning by hand capacity effect must have been somewhat off-putting!

From there on, the circuit is a normal leaky-grid detector. Note, however, that although the grid leak resistor is shown on the circuit as '2Ω' its value is actually two megohms — the capital omega was often used to represent megohms at the time. Ohms were represented by a small omega, as shown on the filament rheostat.

Provision is made for two sets of phones. If one set is used, it is connected horizontally between pins 1, while if two pairs are used they are connected each between pins 1 and 2.

So, how did the second tuning stage tune the long wave bands? The answer is that it didn't. The tuning coil part of the reactance unit acts merely as an RF choke, and the signal is capacitively coupled to the grid of the detector stage. The tuning capacitor and reactance unit would have no effect. Given that there was perhaps one, may be two, long wave stations, one tuned circuit was probably adequate.

Such radios are rare in Australia. Contemporary literature suggests that they were not sold here as such, so they must have accompanied migrants or have been especially imported.

When restoring a set such as this, bright emitter valves should be used if they can be



**Fig.2: An RCA Radiola III with its WD11 valves in place.**



obtained. There are two reasons. The first is to be authentic; and secondly, the filament rheostats are very low in value, typically 2 - 5 ohms and therefore might not give enough variation in filament voltage for stable operation if 'normal' triodes were used.

### The Radiola III

We're now going to talk about a Radiola — an American RCA Radiola, not an AWA Radiola! This compact little set is beautifully made, as hopefully you may be able to see from Fig.2. Its circuit is shown in Fig.3.

The terminals numbered 1 to 4 on the left of the circuit diagram refer to the terminal posts on the right hand side of the front panel(!). There is provision for a long or short antenna at either terminal 1 or 2, and the earthing link connects either pin 3 or pin 4 to earth, thereby altering the tuning range.

The tuning coil is an interesting affair — a kind of double variometer. It is wound quite as it is drawn; a continuous coil wound in sections as illustrated along a former of about 2" diameter and about 5" in length, with rotors at each end as indicated by the circuit. The first rotor is wound in such a way that it adds to or subtracts from the inductance of the main coil, thereby altering the resonant frequency. The second rotor adds to or subtracts from the amount of energy fed back for regeneration purposes. The rest of the circuit is quite conventional for the times.

The tube types for the Radiola III are the low consumption WD11's. These valves have what is essentially a 'European' triode base, with the same connections, but with 'American' style pins. The anode pin is thicker than the other three.

As WD11's are fairly scarce nowadays, replacements are a problem. One trick is to re-base a type 199 with an European base, and then place a brass sleeve over the anode pin to bring it to the required thickness. If sleeving the tube is not done in this manner, the valve will not fit snugly into the socket.

### Other US two-valvers

The Americans weren't keen on two-valvers. It seems that the manufacturers preferred to throw in a couple of extra stages, to be sure that loudspeaker strength was available at all times. Searching the literature to hand at the time of writing revealed only the Crosley model 51, the Grebe '13' regenerative receiver tuning 80 to 300 metres (which is really a 2-stage tuner), the Grebe CR-18 short wave receiver and the Radiola R5. A case could be made for an Attwater Kent two-valver made up of selected AK components in kitset form.

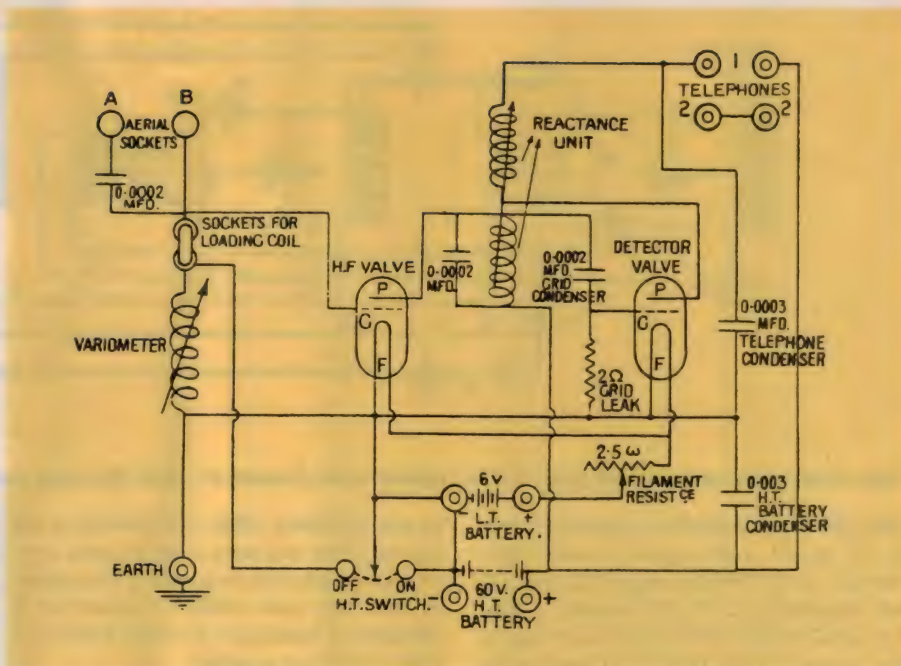


Fig.1: The circuit of the Gec-o-Phone model BC 2001.

### British sets

The British manufacturers were a little more forthcoming in offering two-valve sets to their public. Here are some of the better known brands: Ericsson; 'Fellophone' (of the Fellows magneto family); 'Gec-o-phone', made by the General Electric Company; 'Marconiphone' model V2 in their various updates; Stirling; Western Electric; Radiax; Cosmos; the Radio Instruments model V2A (funny about that!); British Thompson Houston or 'BTH'; 'Ethophone' by Burndept; AJS, of the same stable as their famous motor cycles; and last but not least, Edison Bell and their 'Bijou' brand.

Most of these sets, particularly the earlier ones, were housed in anything but conventional coffin box cabinets. There was a variety of sloping panels, 'tobacco cabinets' and exposed bright emitter valves.

### Australian sets

As has been discussed in the various snapshot years, many of the early sets sold in this country were assembled by various licensed experimenters who placed their own names upon them. David Jones' store and Farmers Company in Sydney, and Harringtons and Hartleys in Melbourne, all advertised extensively for two-valve sets either of their own brand or in kitset form. Prices for these sets started from as low as £10, with of course, valves, phones and batteries being classed as 'extras'. Other states had their major suppli-

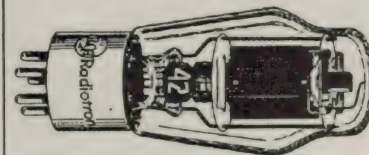
ers as well, and they also had the usual run of dealers-cum-manufacturers.

The valves for these sets were much the same as for single-valvers. That is, early in the piece, the bright emitters such as Ediswan, Philips D1 and D2, type 'E' and type 'R', and finally the 201 and 201-A. In the majority of circumstances the same valve was used in each socket.

RCA introduced a special 'detector' type 200, followed by the 200-A. This valve had a minute amount of gas inserted into the

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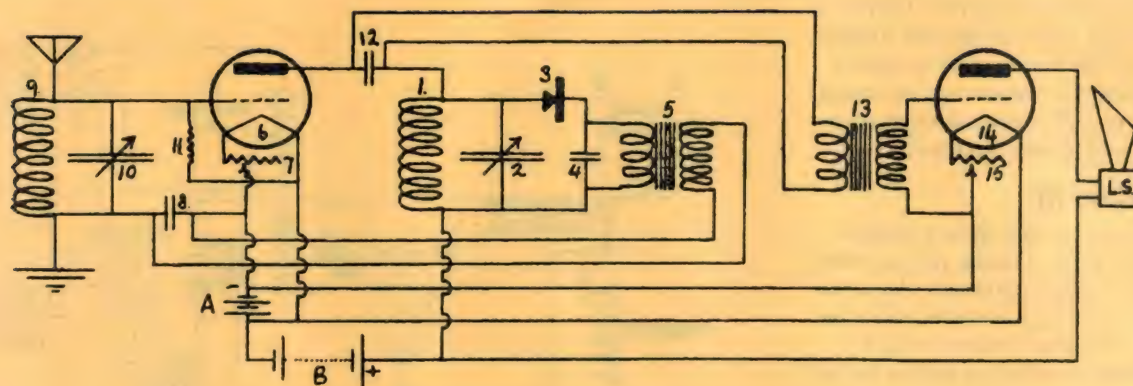


Fig.4: A two-valve reflex circuit given in *The Listener In* for October 31, 1925. Wired as shown, it wouldn't have worked properly at all...

bulb, and when worked on an anode voltage of 20 to 45 volts, good results were claimed. In the Philips range, the type D1 was regarded as a 'high frequency' valve (i.e., detector) and the type D2 as an 'amplifier' or audio valve. In reality, there was little to choose between them.

By about 1925 the ubiquitous 201-A had permeated just about everything, and remained supreme until the introduction of the low consumption types.

## Reflexing

This period of radio history was the heyday of the reflex set, and reflexing was not particularly practical for more than two valves. To recap upon the reflexing principle, one valve was made to act as both an RF amplifier and an audio amplifier, using a 'cats whisker' crystal as the detector.

In a one-valver, the reflexing was exactly

as just described, while in a two-valver the second valve was most often an extra stage of audio, sufficient to operate a loudspeaker. The two-valve reflex set described in *The Best of Australia's Wireless Weekly* for 1927 shows just a circuit.

Occasionally, there were reflex sets which claimed they could do a little more. The circuit shown in Fig.4 appeared in the rival magazine *The Listener In* for October 31, 1925. The numbered components are referred to in the text, and no component values are given. However the explanation leaves more than a little to be desired.

Yes, the received signal appears at the grid of V1, and yes, it is capacitively coupled to the RF tuning stage, whereupon detection takes place by the cats whisker and the audio is fed to the primary of the audio transformer (5). Let's quote from the text:

*Once having reached our old and*

*unchanged friend the 1-2-3-4 detector tuner combination, the current's character is changed and returned by the audio transformer. From here it makes a second tour of the circuit, but this time round, parts that were short cuts on the first trip have now become obstacles, and vice-versa.*

*High-frequency shunt-condenser 8 does not by-pass rectified current, so it must, on the one hand, traverse coil 9 to the grid, and, on the other, proceed to A-.*

Oh really? It is hard to imagine indeed one ounce of signal from the secondary of T5 reaching any grid when the secondary is connected to A- and earth! Perhaps if capacitor 8 was connected between the bottom of the tuned circuit and earth, and the tuned circuit was connected to A- (as if C8 was not there as shown), and the secondary of T5 was connected across C8 in its new position, the circuit may just work! With the wiring alterations as described, the grid leak R11 now has some relevance. It will be required to allow for the earth return of the grid circuit, which would now be locked by C8.

In short, if the circuit worked at all, it must have been wired somewhat differently from Fig.4...

Despite the curious circuits described, it can be said safely that the majority of two-valvers were indeed regenerative detectors, transformer coupled to an audio stage for headphone use. Under favourable conditions, and by cranking up the voltages, loudspeaker reception was possible. More than a few of these sets were home built, and some have endured to this day. Sadly, home-built sets seem to be the ugly ducklings of collectable items.

Soon we'll look at two-valvers from 1927/8 and into the electric era. With pentode valves, the two-valver came to be seen in a different light altogether. ♦

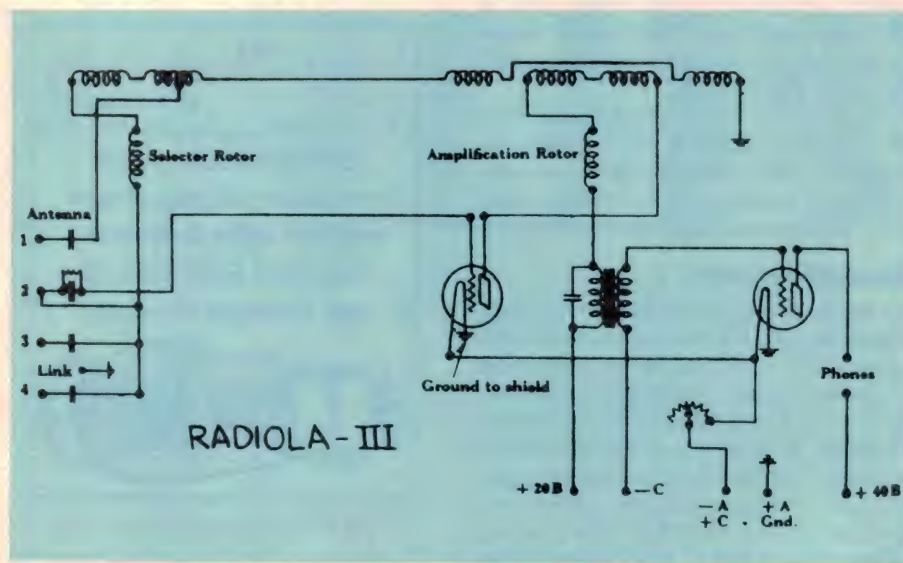


Fig.3: The circuit of the Radiola III two-valver.

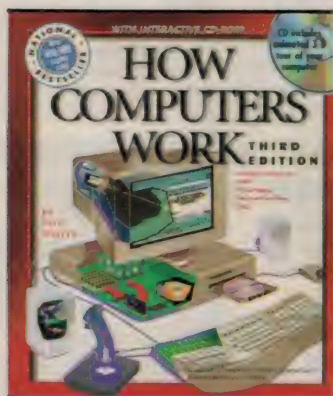




# New Books

## Updated classic

**HOW COMPUTERS WORK**, by Ron White. Third edition, with interactive CD-ROM, published by Macmillan Computer Publishing (Que imprint), 1998. Soft cover, 256 x 218mm, 292 pages. ISBN 0-7897-1650-X. RRP \$74.95.



Here's the third edition of this award-winning book. It has been updated and expanded, and covers not only the basics but also recent PC enhancements such as Pentium Pro and Pentium II processors, MMX, virtual reality, the USB bus, web audio and video, DVDs, PC cards, digital cameras, colour printers and so on. It's also bundled with an interactive CD-ROM giving a video tour inside a PC, video clips of experts and so on.

Like the earlier editions it's profusely illustrated, with excellent four-colour drawings from illustrators Timothy Edward Downs and Sarah Ishida Alcantara. In fact the superb illustrations and concise text initially tend to mislead you into thinking that it's a relatively low level book for young people. It's only when you begin reading it properly that you discover it's surprisingly thorough and informative, taking most of us about as deeply into both hardware and software operation as we'll ever want to go.

For example I found it clarified a number of detailed aspects of the PC boot-up sequence that I still hadn't got straight, after all these years of working with PCs. Similarly I found chapters four ('How the BIOS and Drivers work') and five (How Plug and Play works) surprisingly helpful...

There's just one area where the book is strangely quite *unhelpful*: how to run the companion CD-ROM. I couldn't find a single word in the book itself on this, or even which operating systems it's compatible with. I had to load it into the CD-ROM drive, cross my fingers and hope it would either self-install whatever software it needed, or at least pro-

vide a readme file which would discuss compatibility issues and explain how to proceed. There was neither; just a SETUP.EXE that turned out to be only semi-compatible with my NT4 system. Rather disappointing...

Apart from that one failing, though, the book is an excellent production. It's both accessible and informative, and would therefore be hard to better as an introduction and reference to the operation of today's PCs.

The review copy came from distributor Prentice-Hall Australia, of Locked Bag 507, Frenchs Forest 2086. (J.R.)

## Practical telephony

**TELEPHONE INSTALLATION HANDBOOK**, by Steve Roberts. Published by Butterworth Heinemann, 1997. Soft cover, 156 x 234mm, 156 pages. ISBN 0-7506-3427-8. RRP \$55.

One of the most significant changes since the deregulation of the telecommunications industry is that virtually anyone can now make alterations or additions to their telephone wiring. Of course there are rules and codes of practice, as for electrical wiring. But gone are the days when you had to wait a fortnight to get an extension phone outlet. As well there's now a huge range of telecommunication devices available — fax machines, modems, answering machines, different types of phones and so on.

This book covers most aspects of telephony from an end user point of view, including installation techniques, fault finding and



descriptions of devices that connect to the PSTN (public switched telephone network). It is aimed at technicians, systems managers and anyone who prefers to work on their own telephone installation. It's not highly technical, but instead gives basic principles and lots of practical examples that show how to add an extension phone outlet, a telecommunication device or a complete PABX system. Naturally there are circuit diagrams, but anyone with some electrical knowledge will

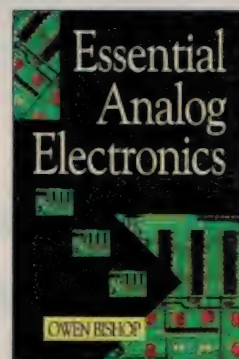
find these easy to follow.

Being a UK publication, the book is written for UK and USA equipment and regulations, but many of the basics also apply in Australia. It's well illustrated and easy to read, and is quite up-to-date. The review copy came from Butterworth Heinemann, PO Box 251, Port Melbourne 3207. (P.P.)

## Analog electronics

**ESSENTIAL ANALOG ELECTRONICS**, by Owen Bishop. Published by Butterworth-Heinemann (Newnes imprint), 1997. Soft cover, 234 x 155mm, 287 pages. ISBN 0-7506-2898-7. RRP \$50.

In this era of ever-faster transition to digital technology, it's easy to forget that analog circuit operation at both the macro and micro levels still plays a crucial role in underpinning ALL electronics — and will do so well



into the future. Those involved in the design of high-speed chips and subsystems are only too aware of this, when their projects don't perform digitally as planned...

This latest book by well-known author Owen Bishop (also a contributor to *EA*, nowadays) provides a good introduction to basic analog electronics concepts, starting with input transducers ('capturing analogs') and moving through the processes of originating analog signals, conditioning them, amplifying them, filtering them, transferring them from A to B (communications), storing them and so on. The treatment is largely qualitative and intended to give a good grasp of the concepts involved, although there's enough basic maths to round out the student's knowledge and understanding.

The style tends to be toward the concise, but on the whole it's very readable. For those just beginning the journey into a real understanding of electronics, it would make a good primer and reference.

The review copy came from Butterworth-Heinemann Australia, PO Box 251, Port Melbourne 3207. (J.R.) ♦



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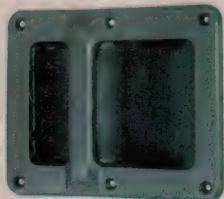
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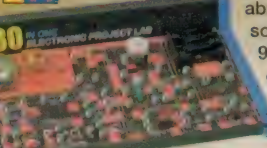
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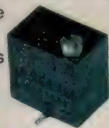
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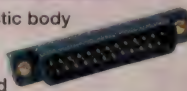
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# 240V VARIABLE FREQUENCY DRIVE

**Designed to power small synchronous motors used in belt drive turntables, this unit gives sinewave output, fine speed adjustment and electronic changeover of 33.3 and 45rpm. With an output power rating of 14 watts, it may also be suitable for other applications.**

**by Phil Allison**

**A**lthough Compact Discs have virtually completely superseded the black vinyl kind in the marketplace, there are millions of 12" and 7" disks in people's homes and the turntables to play them. In spite of the fact that most of the famous brands of turntable have disappeared, some expensive hifi models are still available. However at least one of these has no provision for 45rpm recordings, and a famous Australian made budget hifi unit of the past (the 'JH Synchronous') typically runs a few percent faster than the correct speeds. The author owns a fine example of the later unit, and the desire to correct this speed error inspired the design of a small variable-frequency drive with 240 volt output.

## Design concept

The modern high-tech way to produce variable frequency drives for induction motors involves the use of pulse width modulation driving sets of high voltage MOSFETs operating from a rectified mains supply under microprocessor control. Such drives are made for motors up to a few horsepower and are quite understandably not cheap. I reasoned that something less ambitious could

drive a turntable motor; possibly a sine wave oscillator producing the appropriate frequencies feeding an IC power amplifier module driving into a step-up transformer would do the job (see Fig.1).

Measurements showed that typical small synchronous motors used in turntables draw less than 50mA from the mains and so, allowing for losses, an amplifier with an output rating of 15 to 20 watts should be adequate. Expecting that a mains transformer operating in the reverse sense would provide the voltage step-up function, a likely candidate was briefly tested being operated that way. The outcome was, suprisingly, that it was quite unusable in this role.

Why don't mains transformers work in reverse? The short answer is that the driving amplifier overheats badly and the transformer emits an unhappy growl when operated at around 50Hz — both effects disappearing above about 85Hz or if the output voltage is reduced below 180 volts.

The basic cause is magnetic saturation of the transformer core — but why is there no problem when it's used the other way around? An example will make the phenomenon clearer:

The popular type 2155 multitapped trans-

former of 15VA rating would seem to be capable of doing the job, but in fact cannot. When measured off-load with 240 volts on the primary, the magnetising current is 40mA RMS. This is normally supplied by the mains and causes only slight heating of the primary. However, when operated in reverse the magnetising current must now be supplied from the drive amplifier, and is increased in size by the turns ratio of the transformer — i.e., by about 24 times.

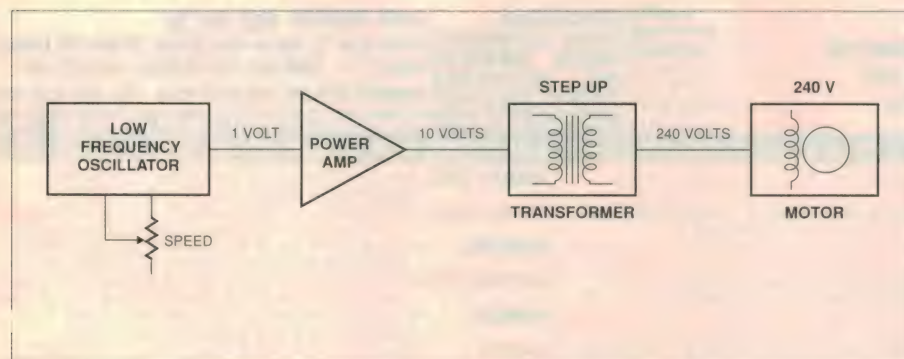
Measured again with no load, the current into the 9.6 volt tapping to achieve 240 volts at the output was 0.94 amps RMS. The 1A rating of this winding had been consumed in magnetising the core, leaving nothing for useful loads!

Worse still, the current has a very distorted waveform, with peaks of 2A at each zero crossing of the drive voltage. A high current at zero volts is very similar to an output short circuit condition on the drive amplifier and causes serious overheating. In addition, the internal 'safe operating area' or SOA limiting system of the power IC is likely to react and shut the chip down.

Replacing the 2155 with the similar 2156 transformer, rated at 30VA, provided no solution either as it proved to have an even higher magnetising current.

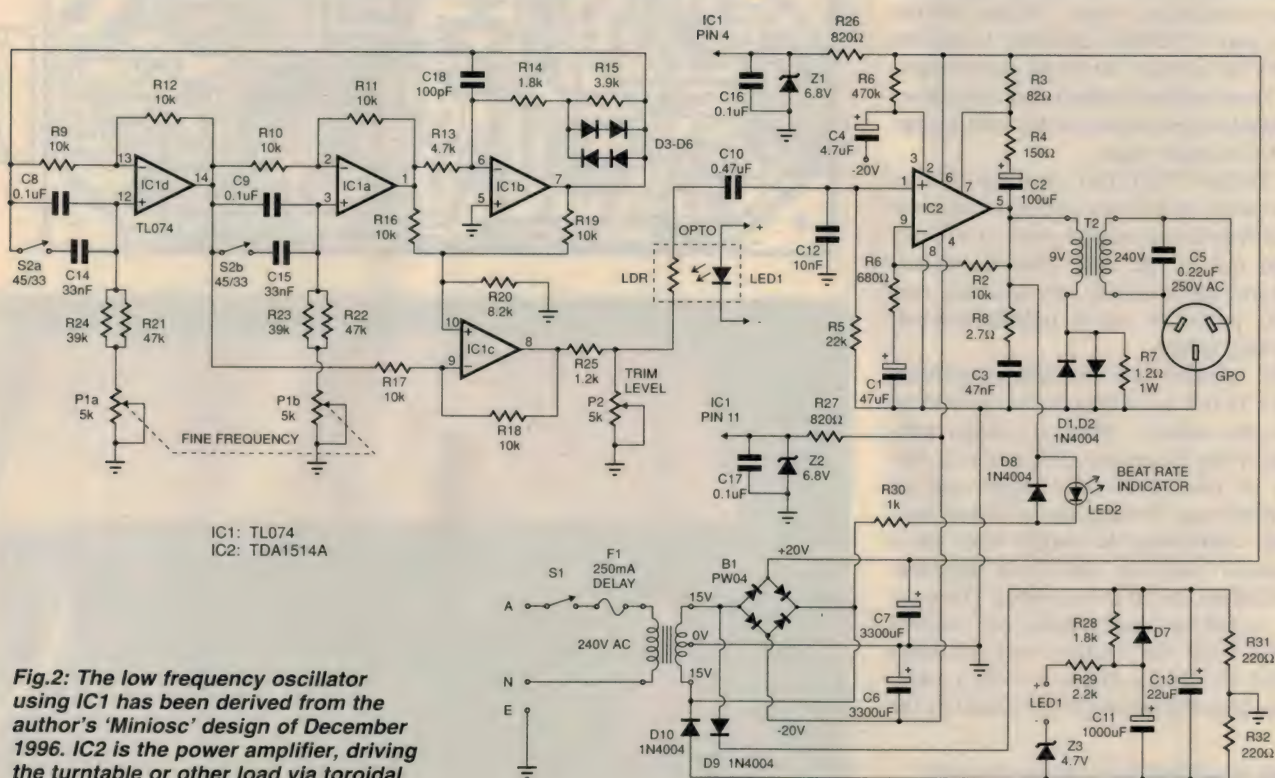
The above findings are not meant as a serious criticism of these transformers, by the way. Their designers and manufacturers simply do not intend that they can be operated in reverse mode.

A possible solution is to drive two such transformers with their secondaries in parallel and 240 volt primaries in series at around half the normal voltage. Doing this almost eliminates magnetising current, but doubles the resistance at the output — meaning that both transformers would have to be fairly large. Ideally a specially wound transformer is needed, but there was yet one other and much simpler option not tried.



**Fig.1: The way it works. The output of the low frequency oscillator is amplified and stepped up to produce 240V.**





**Fig.2: The low frequency oscillator using IC1 has been derived from the author's 'Miniosc' design of December 1996. IC2 is the power amplifier, driving the turntable or other load via toroidal step-up transformer T2.**



### Use a toroidal!

Now the magnetising current of typical toroidal mains transformers is miniscule, so it is likely that reverse direction operation should be possible. Mini 20VA and 30VA sizes are now kept in stock at several dealers, so one with a suitable secondary voltage was purchased and placed on test — with complete success.

The main reason for the difference is the toroidal's use of grain oriented wound steel cores. The particular toroidal purchased only draws 2-3 milliamps from the 240V mains off-load, and only a few more milliamps when operated at 260V from a Variac. When operated in reverse the current drain increased to only 60mA, which is a much more acceptable value for the drive amplifier to supply.

Having solved the transformer problem, the rest of the design could now be done and is as follows.

### Design details

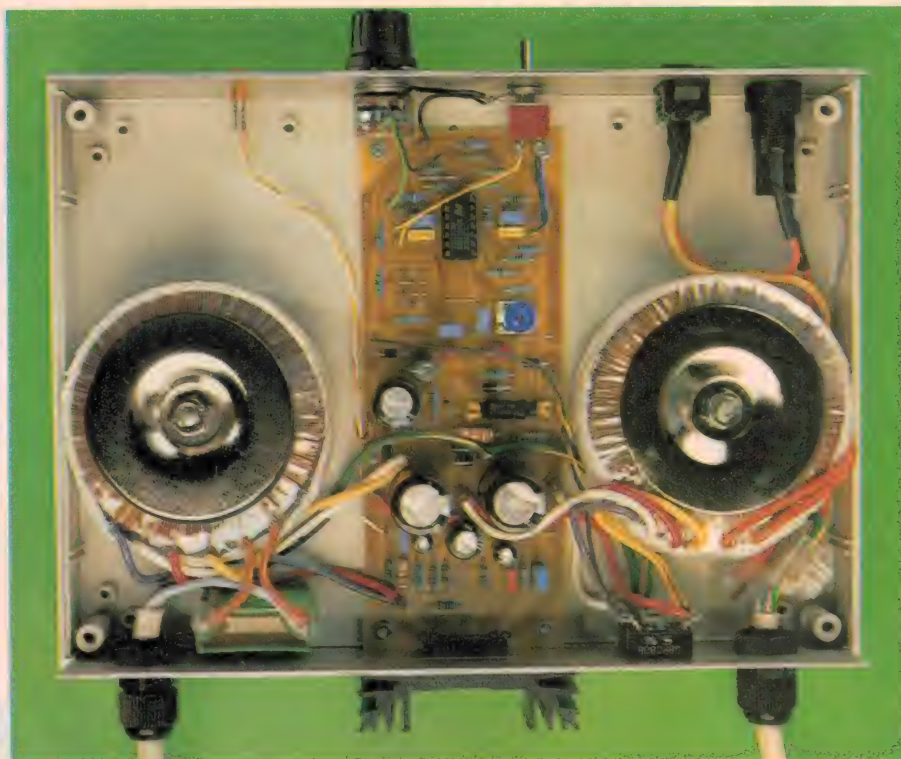
By employing a second small toroidal in the power supply, the particularly compact unit presented here became possible. Constructors may elect to use a conventional transformer in the power supply if they have one on hand, but this will mean using a much larger enclosure and there may be problems with external hum fields if it is placed near the turntable.

Referring to the main circuit diagram, the power transformer feeds a bridge rectifier and a pair of 3300uF capacitors to provide +/-20V DC supplies for the IC power amplifier. These rails are further resistor and zener regulated to plus and minus 6.8 volts to supply the oscillator stage.

A Philips TDA1514A amplifier IC provides power to drive the step-up transformer and is specified as capable of up to 40 watts output into an 8Ω load. Features include good thermal overload, safe operating area (SOA) protection and a reliable two-bolt mounting system.

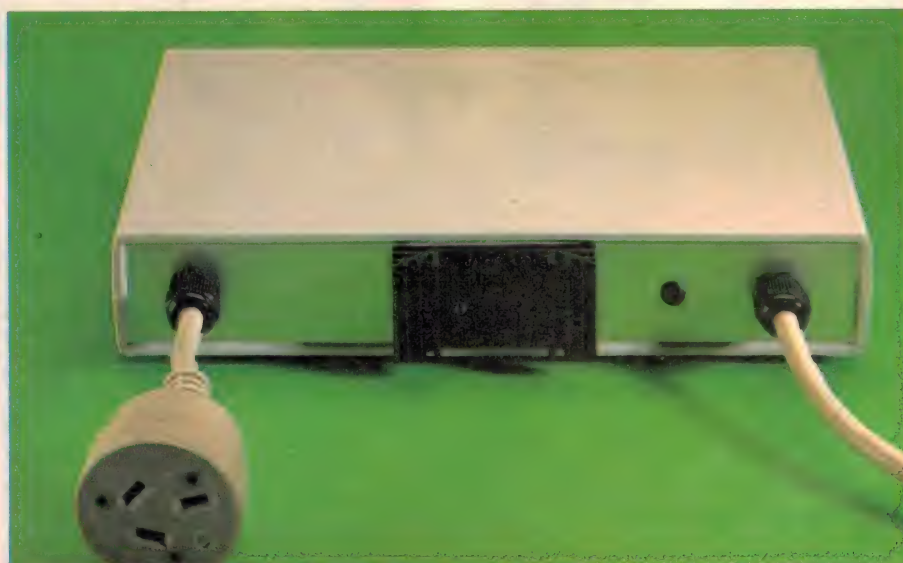
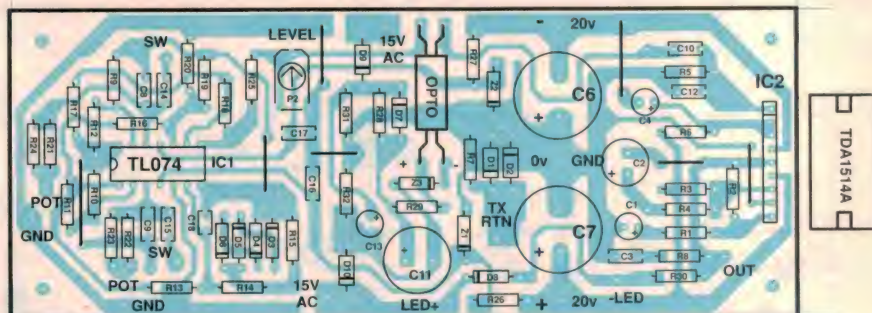
The variable low frequency oscillator uses a TL074 quad op-amp and is derived from the author's 'Miniosc' design published in the December 1996 issue. It consists of two phase-shift stages and an inverting stage forming the oscillator, with diodes controlling the output level and a combined summing and third harmonic cancellation circuit at the output. There are two switch selected ranges, one centred around 50Hz for 33.3rpm and the other around 67.5Hz for 45rpm — with a variation of plus and minus 10% provided by the

**At the rear of the case, there's only the heatsink for the power amplifier module, and the power supply and output cords passing through cable glands.**



**Above: Inside the author's prototype. As you can see, a second toroidal transformer was used in the power supply.**

**Fig.3 below shows the parts location on the PCB.**





5k $\Omega$  dual pot. This oscillator circuit arrangement gives a low distortion sinewave output of constant level and has very good frequency stability.

Some readers may imagine that crystal-derived frequencies would be the ultimate for turntable speed control, but not so. The facility to 'fine tune' the frequency is needed to obtain accurate 33.3 and 45rpm speeds on the turntable platter. Mechanical factors can prevent the synchronous motor achieving phase lock to the supply frequency, and even the condition of the drive belt also has its effect on the platter's final rpm...

## Soft-start circuit

When the design was first prototyped, the TDA1514A power IC would hiccup (SOA limit) several times at switch-on, due to low frequency transients produced by both the VFO starting up and also the power IC itself when attempting to un-mute. A simple delayed un-muting system using a relay was then tried, but without complete success as the relay created another smaller transient when it operated.

The method finally adopted employs a simple linear opto-coupler consisting of an ultra bright clear red LED illuminating a small light-dependant resistor (LDR). The LDR specified has a dark resistance value of many megohms, reducing to around one thousand ohms when the LED is illuminated. The LDR's resistance in conjunction with R5, the 22k input resistor for IC2, form a light controlled attenuator with a range of about 50dB.

The driving circuit for the LED has its own DC supply derived from the power transformer secondary, designed so that it will discharge itself quickly after the mains is removed. The network involving C11, R28, R29 and zener Z3 provide a delayed and then gradually increasing drive current to the LED after switch-on, and hence a delayed and smooth fade-up of the VFO's signal to the power IC. After switch off, D7 discharges timing capacitor C11 into R31 and R32 in about one second, so the cycle can be repeated. This circuit has removed any transients at switch on.

## The power stage

The TDA1514A power IC, although very good, is designed for 8 $\Omega$  and 4 $\Omega$  speaker loads and not for the special situation of driving the low voltage windings of a transformer. As well as the need for a 'soft start', small DC offsets at the IC's output can cause significant standing DC currents in the IC and transformer. This is because the two paralleled secondary windings of the step-up toroidal have a combined DC resistance of only 0.3 ohms.

The big problem is not however due to DC current heating the power IC, but the magnetic field being offset in the trans-

## Resistors

Either 0.25W 1% metal film, or 1W 5% carbon film:	
R1	680 ohms
R2,R9-12, R16-19	10k
R3	82 ohms
R4	150 ohms
R5	22k
R6	470k
R7	1.2 ohms, 1W
R8	2.7 ohms
R13	4.7k
R14,28	1.8k
R15	3.9k
R20	8.2k
R21,22	47k
R23,24	39k
R25	1.2k
R26,27	820 ohms
R29	2.2k
R30	1k
R31,32	220 ohms, 1W

## Capacitors

C1	47uF 25V RB electro
C2	100uF 50VW RB electro
C3	47nF 100V MKT
C4	4.7uF 50V RB electro
C5	0.22uF 250V AC mainscap
C6,7	3300uF 25V RB electro (max height 32mm)
C8,9	0.1uF 100V MKT
C10	0.47uF 63V MKT
C11	1000uF 25VW RB electro
C12	10nF 63V MKT
C13	22uF 63V RB electro
C14,15	33nF 100V MKT (5%)
C16,17	0.1uF 63V MKT
C18	100pF ceramic

## Semiconductors

IC1	TL074CN, LF347
IC2	TDA1514A
D3-6	1N4148

former's core due to DC passing through the windings. DC currents of more than a few tens of milliamps cause asymmetrical saturation of the transformer, resulting in both output waveform distortion and a peaky current drain. To eliminate this effect, a parallel network of back to back diodes and a 1.2 $\Omega$  resistor (D1, D2 and R7) has been placed in series with the trans-

## Toroidal transformers — a note

The VA ratings given to similar transformers sometimes vary considerably from one maker to another, as different makers specify their designs at varying regulation factors and temperature rises. It would be helpful if transformer makers quoted the resistance of primary windings as an indication of the transformer's regulation and self heating. For the design presented here, the mains and step-up transformers should have primary resistances not greater than 95 $\Omega$  and 130 $\Omega$  respectively, and might be described as either 20VA or 30VA with a diameter of 75mm and height of 30mm.

## PARTS LIST

D1,2,7, D8-10	1N4004
B1	PW04 6A bridge
LDR	Jaycar RD-3480 or equiv.
Z1,2	6.8V 400mW zener
Z3	4.7V 400mW zener
LED1	5mm red ultra bright, 2000mcd/30°
LED2	5mm, standard amber

## Miscellaneous

PCB	148mm x 58mm, code 98vfd3
T1	240V/15V + 15V, 30VA toroidal (or E-core)
T2	240V to 9V + 9V, 20VA or 30VA toroidal ONLY
F1	20mm x 5mm, 250mA slo-blo, mains approved
S1	SPDT plastic mini-rocker, 250V AC rated
S2	DPDT mini-toggle
P1	5k linear dual, DSE R-7653 or equivalent
P2	5k trim, 5mm x 10mm horizontal
Instrument case, Jaycar HB-5982 or similar with aluminium panels; 14-pin DIL socket, dual wipe or machined pin; 30 x 60mm finned heatsink, Farnell 175-009 or similar; 3m mains extension lead, for mains input and output cables; knob 20mm diam- eter, to suit P1; 20mm x 5mm panel mount fuse holder; 2 x cable clamp glands; five 12mm x 3mm bolts with nuts and washers; two 20mm x 3mm bolts with nuts and washers; insulator for IC2 (25mm x 15mm); 20mm x 8mm and 100mm x 4mm diameter black heatshrink tubing; 18 x 1mm PCB terminal pins; 200mm multi-colour ribbon wire; four-way mains terminal block. Note that the TDA1514A IC is available from Dick Smith Electronics, WES Components (Ashfield NSW) and Farnell Electronic Components. The 20/30VA toroidal transform- ers are available from Jaycar Electronics and Farnell Electronic Components.	

former ground connection to reduce the DC current flow. The two diodes clamp the voltage drop across R7 at about +/-1V.

## PF correction

The load presented by a small induction motor is, not surprisingly, inductive. In the interests of best efficiency a capacitor should be installed across the 240V output to bring the power factor closer to unity and help make the load resistive. I hesitate to use the term 'power factor correction' in the context of such a small load, but it is appropriate and fitting a capacitor does noticeably reduce the running temperature of the power IC and transformers. A 250V AC rated capacitor of 0.22uF should do the job. Those with access to a CRO can simultaneously monitor the voltage across R7 and the output of the power IC and vary the capacitor value to bring the two in phase. Either X-Y operation or dual trace modes could be used.

## The beat indicator

In spite the name, this is not in any way related to disco music but rather a multi-function indicator that shows when the unit is operat-



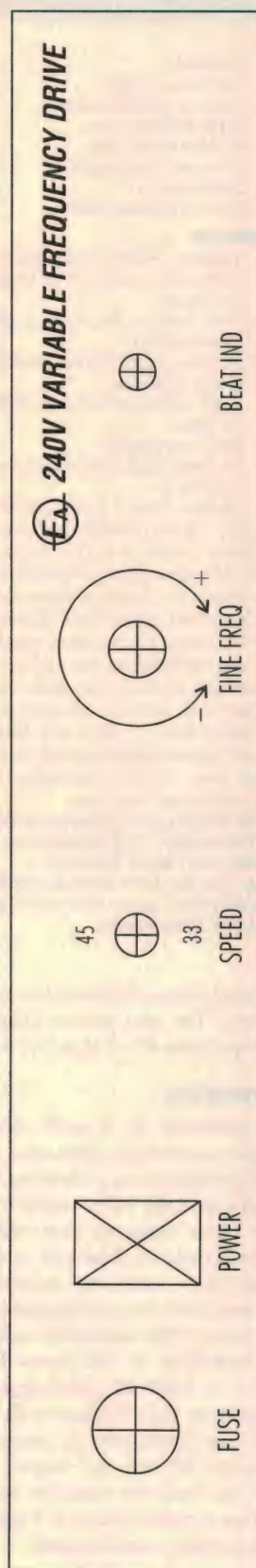


Fig.4: The front panel artwork, reproduced here actual size for those who like to make their own.

ing, which range is selected and the approximate deviation from mains frequency.

An amber LED (the colour is not significant) with  $1k\Omega$  limiting resistor is connected across the output of the power IC and the power transformer secondary. When there is any frequency difference between the two the LED will blink on and almost off at the beat or difference frequency. When the 45rpm range is selected it blinks rapidly and when in the 33.3rpm range the blinking is slower or will cease if the control is adjusted to match the output and mains frequencies.

### Speed setting

Contrary to what is sometimes heard, the mains frequency is quite accurate and stable. Countless mains powered clocks prove the point, by keeping good time for months or years on end, barring blackouts. Mains powered clocks employ either tiny synchronous motors or electronic circuits that count the number of mains cycles and divide by 50 to derive seconds. Measured here in Sydney, I have not found the mains frequency to be out by more than one part in 500 or 0.1Hz. As a result of this the strobe markings on a turntable platter or correctly made strobe disc can be expected to give this same level of accuracy.

A strobe disc will be needed, to use with the variable frequency drive to set precise 33.3 and 45rpm speeds. By the way, spinning strobe markings become visible only under normal mains powered incandescent or *non-electronic* fluorescent light sources. Some modern and most compact fluores use high frequency drive to the tube and hence give no indication with strobe discs — nor will a torch.

Some auditioning, done by the author and friends, indicated that a speed change of only 1% up or down is clearly heard by listeners, being perceived mainly as a change in musical tempo rather than pitch. Also many musical passages 'sound better' played slower by 1-2%. After correcting my own turntable's +4% speed error, re-playing familiar album tracks revealed a major subjective improvement.

### The construction

Presuming you have obtained or made a copy of the PCB, inspect it carefully for voids and whiskers shorting tracks; thankfully these are rare with commercial PCBs nowadays. If not done already, drill out the four mounting holes to 3.2mm (1/8") to accommodate the 3mm bolts.

Check that your PC stakes will fit and drill out the relevant holes if this is not the case. Using the overlay diagram and parts list as a guide, load all the resistors and small components like diodes and wire links first, soldering and then trimming the leads for each component as you go as this helps avoid missed solder joints.

Resistors with 5 band coding should be checked with an ohmmeter where there is any doubt about their value. Some codes will read in both directions and only a ohmmeter tells the truth! Next fit the 14-pin DIL socket, small plastic and electro capacitors, trim-pot and PC stakes if used. After this the larger electrolytics can be installed.

### Making the 'opto'

The opto-coupler has to be made but this is very easy. Take a 20mm length of black shrink tubing with a 7mm hole and just slide the LDR and LED in from each end. Then apply a hot air gun until a neat fit is obtained, as seen in the photo of the PCB. The LED should be in direct contact with the LDR.

A test of the assembled 'opto' can now be done. Avoiding bright light, an ohmmeter check should show a reading in the megohms from the LDR when the LED is un-powered. Now apply a current of 2-3mA to the LED and the ohmmeter reading should drop to less than  $1200\Omega$ . A standard LED does not have nearly enough light output at 3mA to achieve this and an ultra-bright clear type is essential.

Install the 'opto', if all is well, and lastly the TDA1514A IC. This will need to have its nine leads bent before soldering, so as to position the mounting surface back parallel to the edge of the PCB. Use care and do not bend the leads too closely to the plastic package or so sharply that it cracks the metal. A bench vice may be helpful in achieving a good result.

Solder the IC in place, being careful to avoid any solder bridges. The whole board can now be washed in a shallow tray of methylated spirits. Use a small paint brush to help remove solder flux and then replace the contaminated solvent with clean and rinse the whole board. After this, shake dry and warm gently with a hot air gun or hair drier.

Inspect your workmanship for defects and repair as needed; any new flux can be wiped away with a rag dipped in metho and then dried.

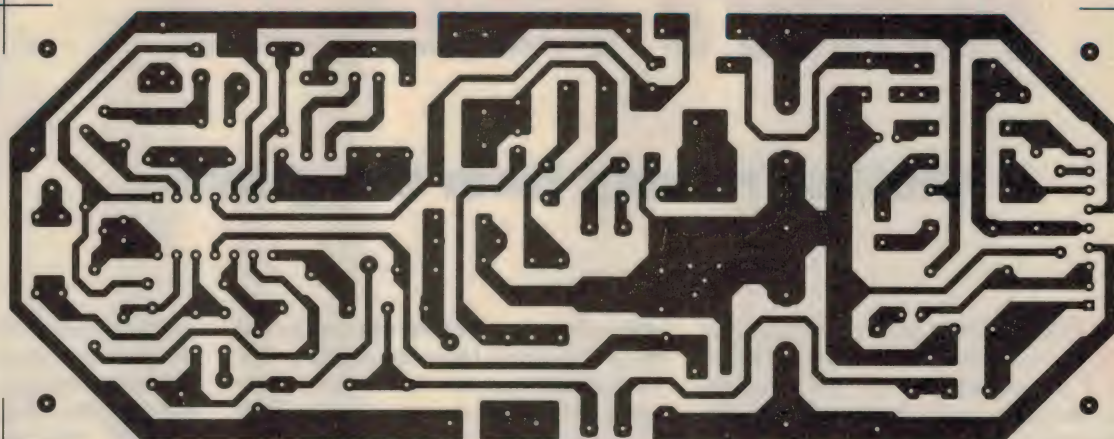
Once you are happy with the result, a trial fit of the PCB in the case can be done. The solder side of the board should be in contact with the bottom of the plastic panel to allow the filter capacitors to fit inside the 40mm high case. Mark the positions for holes with a pencil or scribe. Do a trial fit of all the other components and mark hole positions appropriately.

The heatsink and rear panel can be marked and drilled to match the power IC's bolt spacing of 20mm. The prototype's heatsink was drilled and then had threads tapped into it, but this is not essential. However the back panel must be made from aluminium and if plastic is supplied then make a replacement from some 1.6mm sheet. If the front is left as plastic, then make sure you ground the frames of the speed switch and pot.



Fig.5: The PCB artwork, again reproduced actual size for those who make their own.

VARYDRIV



## Mains wiring

The mains connections are conveniently made by cutting a three-metre extension lead at about 30cm from the female end and using the two parts for inlet and outlet. Pass the leads through cable glands and make sure they are well secured. Carefully mark, drill and nibble or file the holes for the mains rocker switch and fuseholder and install both.

After everything has been fitted, except the PCB, wiring can be commenced and completed up to the stage where the board is fitted. Use shrink tubing over all mains connections and a screw-down block for the mains terminations. Make sure to carry the mains earth connection through to the three-pin outlet, the metal panels and the power supply ground point. The bridge rectifier can be fitted and then wired to the power transformer after it has been bolted down. The range switch and dual pot can have wires attached and trimmed ready for the PCB.

## Commissioning

After checking all workmanship and component orientations on the PCB again, fit it into the case and bolt the power IC through the rear panel to the heatsink. Include the insulator, with a smear of thermal grease on each side, before bolting the IC down.

Connect all wiring to the board EXCEPT for the step-up transformer and apply mains power gradually through a Variac, if one is available. Assuming there is no smoke and nothing else alarming happens, check the supply voltages which should be +20V and -20V on the large electros and +6.8V and -6.8V on pins 4 and 11 of the TL074 socket. The output point of the power IC should be at zero volts

and this IC should not be getting hot!

If all is well, switch off and install the TL074 in its socket and set the trimpot P2 to mid position. Then switch back on and using a digital multimeter on the AC volts range, measure the level at the power IC output and set it to 10.5V

### Specifications

Output frequency	46-56Hz, 33.3rpm range
Frequency drift	62-76Hz, 45rpm range
Harmonic distortion	+200ppm per degree C
Output voltage	0.12% at IC amp output
Output current	235V RMS nominal
Mains supply	60mA RMS max. (14VA)
	230 - 250V AC, 35VA max.

RMS using the trimpot. Check each position of the range switch and operate the variable control pot while monitoring the meter reading — which should vary only slightly.

## Loudspeaker test

If no oscilloscope is available, a loudspeaker may be used to help verify correct operation. With a 33Ω/5W resistor in series for safety, connect it between the output of the power IC and 0V ground to verify that pure tones of low frequency are heard from the speaker and that the controls operate correctly.

The soft start system can also be checked this way, by switching off and on again; a delay and quick fade-up of the tone should be heard.

Only if these checks are all fine should the step-up transformer be connected. Double check that the two 9V windings have been correctly wired in parallel and are in phase, with the respective starts and finishes of each winding connected together.

With the step-up transformer now connected and with your turntable motor run-

ning at 33.3rpm, set the output voltage to 235V using the trimpot. When switched up to 45rpm the output voltage will probably rise slightly, due to the increased impedance of the motor at this frequency.

The 'beat indicator' LED should be flashing rapidly at most settings and slowing to a stop near the centre of the 33.3rpm range. With a strobe disc on the turntable, check that there is sufficient range of adjustment available either side of correct speeds. The heatsink will soon be running warm, but should not become too hot to touch.

The 0.22μF 250V AC capacitor can be installed last of all. In the prototype it has been glued with 'Silastic' to the bottom of the case, with leads cut short and used as terminals for the 240V output connections. The exposed terminals are covered with dabs of Silastic — it's not the mains, but 240 volts can still bite! ♦

## WARNING

There are some turntable motors which cannot be used with this unit because they draw too much current. Such motors are likely to be found in auto-changers and many budget turntables. As a rule of thumb, if the motor pulley is under 10mm in diameter and hard to stop with your fingers, then it is possibly unsuitable. A simple check with an AC milliamp-meter will reveal the actual current drain of the motor and it should not be greater than 60mA for use with the design as presented. To drive larger motors would require both of the transformers and the amplifier's heatsinking to be substantially upgraded.



# Moffat's Madhouse



## Another raising from the grave...

**W**hat to do with an old computer? Sell it? No, nobody wants to buy it. Donate it to charity? Too old. Even charities are too proud to take an old dinosaur like that. Give it to a school? No, they've got plenty of new computers — what do they want a hunk of junk like that for? So all that's left, I guess, is to take it to the tip.

NO! NO! Don't do that! There must be something valuable in it. I mean, some of the cables might be useful for spares. The thing is full of handy screws. Even the power cord is OK. Thus I rescued a computer that was destined for termination, with extreme prejudice.

This machine was an old friend of mine. I'd worked on it before, mostly due to software problems. The owner's kids were pretty active on the machine, and who knows what interesting goodies they brought home from school on disks. Mostly diseases, I'd say.

Eventually the machine started making interesting squealing noises, accompanied by ominous clicks and clunks. This turned out to be the hard drive, and when the computer finally refused to boot, we knew the end was in sight. So the owner decided to abandon the old machine, and ordered a brand new Compaq Presario 'all singing and dancing' multimedia marvel. One very fine machine, actually... And he saved himself a few hundred dollars by using the monitor from his old computer.

I set up the new machine for him, and for the first time, gracefully removed Internet Explorer 4 (an adventure described in last month's Madhouse column). At the end of that operation I eyed his old Windows 3.1 computer standing there forlornly in the corner. The owner said it was now up for sale. I told him not to hold out much hope. And a couple of weeks later (after last month's column had been written), we did a deal. I'd get the old computer, minus monitor, in return for a couple of hours training on his new machine (in other words, I got to play with it).

I did think seriously of turning the old computer into a transplant donor for my

other clients, but... well, the thing just looked too good to wreck. I knew it had a fairly new US Robotics Sportster modem, one of the best on the market. And it had a CD-ROM drive; something I, as a laptop owner, didn't yet possess. There was even a 5-1/4 floppy drive, something that is a bit of a rarity nowadays. The computer was even made of metal instead of plastic, and it let out a healthy CLANG whenever I gave it a 'technical tap'. So I decided to see if I could fix it.

### Unbeatable price

Our local Internet service provider runs a for-sale newsgroup aimed at the northern Olympic Peninsula, within easy travelling range. So I posted an ad: wanted to buy, a hard drive of 200-800 megs or so, and a VGA monitor. Within hours there was a response from a guy only a 10 minute drive from here, who wanted to GIVE me a 475-meg hard drive. Couldn't beat *that* price!

As for the monitor, that was more of a

operating system was on the new hard drive wouldn't discover it was in the wrong computer and go bonkers. Then I plugged everything together, hit the power, and stood back.

BEEP! We have liftoff! Or, as Dr Frankenstein said, "It Lives! It Lives!"

The new hard drive was indeed working, as was a second 81 meg drive that had been lurking within the computer. Everything was just hummin' along. I snooped around the new hard drive to see if there was anything worth ripping off (I got a few true-type fonts!) and then formatted drive C. Clean as a whistle, 475MB. So I transferred the operating system from my boot disk onto the fresh drive, and we had us one fine stand-alone MS-DOS computer.

This was starting to be fun. Remember when we used to get those old taxi radios and turn them into two-metre ham rigs? My old TCA-1674 rig with nearly 20 valves... hung under the dashboard (cars still had them then)... no room for the passenger's knees... and before that, the Pye Reporter. Normal people thought *them* useless too, but there was so much satisfaction getting them going.

And I'm not the only one — here's a comment I picked up on a newsgroup, from some unidentified guy with an Australian e-mail address:

"It's really fun to have a PC that reminds you of where you came from — things move forward so fast, an occasional

rewind (as a second or greater PC, of course) can do you a world of good. I've been downloading all kinds of fun stuff from the Net (on my main PC of course) that was built for 286 and below with CGA and trying it out, and this has really been a blast. OK, I'm a nerd, but I don't look like one ;-)"

He had really gone back to his roots — an old 286 running MS-DOS only, since it was totally incapable of handling Windows. My own new/old machine was a 486DX66, quite a snazzy machine before the Pentiums came out. I thought it would be interesting to see just how well I could make it work, compared with the modern stuff.

But first there was that lack-of-monitor

**Windows 95 in my Texas Instruments Pentium laptop takes 39 seconds to load from the multiple-boot menu. Windows 3.11, on the other hand, just whizzes along on the old 486. Nine seconds after typing 'WIN' it pops up on the screen as a sultry female voice asks "what would you like me to do?".**

problem. Eventually I phoned every computer shop in the area, looking for a used monitor. But since computers are always sold without monitors in this part of the world, people are keeping their old ones. Turns out I was able to borrow a spare monitor from the computer science department of the high school where I teach TV production. So I had enough stuff, temporarily at least, to see if a new hard drive would bring the old computer back to life.

It didn't take long to crack open the patient and install the new hard drive. While I was in there, I swapped the 3-1/2" and 5-1/4" drives so the 3-1/2" would be drive A. I wanted to boot from a floppy, so whatever



problem to deal with. So I went back to that same for-sale news group to issue another plea for a monitor. But there was already an ad: Wanted to donate to charity, a Gateway 2000 computer, complete with monitor, keyboard, etc. A monitor!

Knowing that charities would surely reject his 386 machine, since they had rejected my 486, I e-mailed the guy and asked if he would SELL me the monitor. No, he said, I'd have to take the whole computer, for \$30. He would then donate the money to his charity. Fair enough!

So I came home with yet another load of junked computer, this time in a whopper tower enclosure, which pretty well took over my living room. The computer did work, but it was not very sophisticated, even for me. So I decided I would strip it as needed.

## Taking stock

Back to my re-animated 486. Let's take inventory: A and B floppy drives, C and D hard drives (475 and 81 megs), an E drive (CD-ROM), 33.6 Sportster modem, sound card (mono only), excellent Chicony keyboard with built-in trackball (they don't make them like that nowadays) — plus a re-born virgin computer with MS-DOS boot system installed and no other software.

To get this computer back to factory-fresh configuration, it needed a full MS-DOS install, followed by Windows 3.1. I had a bought-and-paid-for copy of MS-DOS 6.22, the very last version released before Windows 95 came out with its integrated DOS 7. I also had the very last release of Windows 3.1, called Windows for Workgroups 3.11. This was Microsoft's crowning glory before Windows 95. So I very methodically and carefully installed DOS 6.22, and then Windows 3.11. It took about 20 minutes, and everything worked perfectly the first time.

I have developed a specialty in my computer tech support work — I rehabilitate older computers and get them going on the Internet, after the 'experts' have told their owners that they have no choice but to buy a new computer. This 'new' computer of mine, with its 486 processor and 8MB of RAM, is exactly like those I work on — nothing wrong with it, just limited in speed and size. So my 486 is becoming my test-bed to determine what software will run in a machine like this, and what software will just clog up the works. Only yesterday I had to eject Netscape Communicator V4 from a guy's machine, even though he had the specified 16

megs of RAM. Communicator simply froze up on many Internet sites. With Netscape Navigator V3 installed, it ran just fine.

It would be nice to know these things in advance, and that's what my 486 will be used for much of the time. I have decided that no valuable data will be allowed to live on it, so if some new software really screws it up, I can happily reformat the hard disk and start again.

The first really useful thing I learned from this experimental machine was how to make Windows 3.11 run with 256 colour graphics. As it comes out of the box, Win3.11 runs 16-colour graphics only, there is no 256 colour option. This is OK for text-based uses, but Internet pages with their photographic images look absolutely awful. Windows 3.1 people have learned to live with this, thinking that's just the way Windows is.

However, after some spirited snooping around the Internet, I found a file called SVGA.EXE which contains all the goodies needed to make pictures pop up in glorious full colour under Win3.1. There's a video driver to be installed, and some special fonts to take advantage of the new colour capabilities. Be warned that this does not work on some really old graphics cards, in which case Windows will not run at all. So you may have to use a text editor under MS-DOS to go into SYSTEM.INI and hack your video driver back from 256VGA to VGA.

I'm sending SVGA.EXE along to be posted on the Electronics Australia BBS (and perhaps also on their web site, if it's now online), or you may be able to find it directly on the Internet.

As the re-born 486 stands now, I have set it up as I'd like my clients to have their oldies set up. Many clients have games stashed in their MS-DOS area, so I have two great 'Epic' pinball machines installed in mine. Smooth and fast, as only MS-DOS can do it. I also have the old Version 4 of Microsoft Flight Simulator running. This enticed me to spend some actual money on the machine — for a joystick. And I got a pair of speakers for the sound card as well, so I can hear the pinball machines go 'clunk-clunk'.

Windows 3.11 is devoted almost entirely to Internet purposes at this stage. It's using what I consider to be my ideal setup: Trumpet Winsock for the Internet connection/dialler (another fine Tasmanian product...), Opera 3.2 for the WWW browser, Eudora 1.54 for E-mail (accessing three different accounts), WS\_FTP for downloading

and uploading files, and NetTerm for doing things like raiding the card catalog at the State Library of Tasmania while sitting at my desk in Port Townsend, Washington.

## What's been gained?

With a setup like this, I start to wonder what we actually *gained* with Windows 95. Windows 95 in my Texas Instruments Pentium laptop takes 39 seconds to load from the multiple-boot menu. Windows 3.11, on the other hand, just whizzes along on the old 486. Nine seconds after typing 'WIN' it pops up on the screen as a sultry female voice asks "what would you like me to do?".

Internet operation, especially browsing with Opera, is quite astounding. Pictures and text just zip onto the screen. I am now convinced the whole setup nicely outruns my Pentium laptop with its 56k modem by a fair margin, possibly because it's not burdened with supporting Windows 95.

All this makes me wonder — just where are we going here? And why? Windows 3.1 came on six floppy disks, say 8MB. Windows 95 comes on something like 29 floppies. As for the forthcoming Windows 98, probably 'introduced' upon us by the time you read this, expect a typical install to munch up 160 megs of your hard disk, with a full installation running to 300 megs. Remember that every megabyte on the hard disk has to be loaded into the computer's memory to do something useful. More time, more memory, more horsepower. Is this progress? ♦

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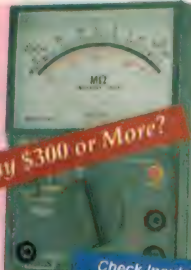
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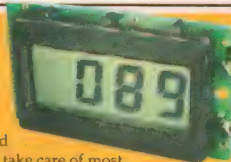
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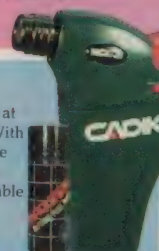
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Frequency: .....10kHz, 100kHz, 1MHz, 10MHz  
Resistance: 400Ω, 4kΩ, 40kΩ, 400kΩ, 4MΩ, 40MΩ  
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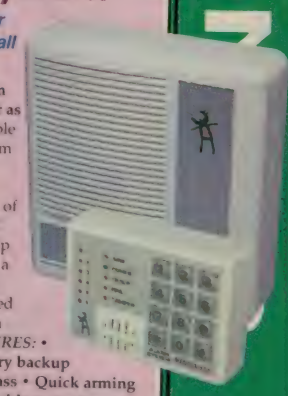
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# Information Centre

by Peter Phillips

## Black boxes, op-amps, input resistance and more

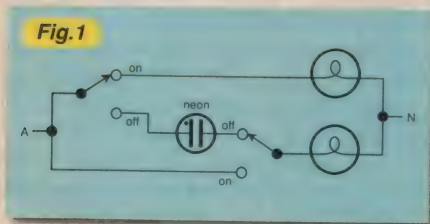
**This month I'm devoting the column to discussion on some of the recent What?? questions. We look at light switching circuits, discuss the meaning of input impedance, and generally extract a lot of useful and practical information.**

**T**he number of letters I receive about our What?? questions shows just how popular they are. Some of these take me to task on the answer, others give alternative answers, and some discuss practical aspects of the question. So I think you'll find it interesting, as we let as many readers as possible have their say about our recent What?? questions. We start at March 1997.

### Light-on indicator

This question, sent by Graham Leadbeater (Ringwood, Vic) asked for a circuit in which a single neon indicator would show if either of two garden lights was on. You were allowed no other components and you had to use conventional single pole light switches. The answer supplied by Graham is shown in Fig.1. Note that the neon indicator is off when either of the garden lights is on.

In December 1997, I included a letter from Jim Thornton (Palm Beach, Qld), who felt the answer to the question had a few drawbacks. Jim's circuit is shown in Fig.2, in which the neon still indicates if either of the garden lights is on, and the



**Fig.1: The answer to our March 1997 What??**

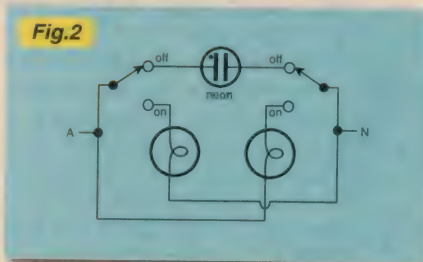
neon current no longer flows through a lamp filament. But...

*I have two objections to Jim Thornton's circuit: the need to run a neutral wire to one of the switches, and more seriously, one of the lamps is supplied with an unswitched active. (J. Knowles, Yinnar, Vic).*

The comments above are echoed in a letter from 'Dr Henry Choke', who points out:

*Consider the case where someone is changing a globe. Accidental contact with a socket terminal could be lethal, while the original answer ensures the shock current is limited by the neon indicator. This current, like that taken by a neon test pencil, would hardly be felt.*

As well, a blown globe will be indicated by the neon remaining off, which is the 'alert' state for the indicator.



**Fig.2: The suggested answer to March 1997's What — but is it better than the original answer?**

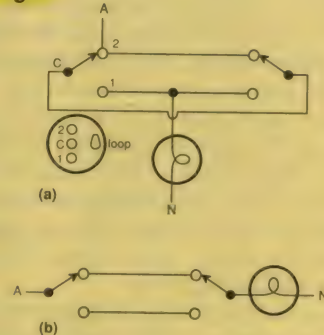
If a circuit presents a danger, then it's clearly not as good as a circuit that doesn't. So Jim, I guess your circuit solves some problems, and raises a few others.

### The plumber's mistake

This question was about a two-way light switching circuit, to which an obliging plumber had fitted a light dimmer. Unfortunately, after this addition, the circuit was no longer two way, even though the dimmer and one switch worked. While no one has doubted the answer, Andrew Mayor (via email) made a couple of points worth noting about how the circuit was originally wired. This circuit is shown in Fig.3(a), by the way, along with the usual way (b).

*An advantage of variant (a) is that*

**Fig.3**



**Fig.3: A two-way light circuit. (a) shows a method sometimes used, while (b) shows the usual method.**

although it uses an extra wire to link the two switches, and thus requires four-core cable if an earth is also needed, it provides an accessible active at the switches for other light circuits. The colour coding of the four-core cable also makes it clear the circuit is non-standard.

Conventionally, circuit (b) is often wired with three-core cable, and it's imperative to sleeve the neutral line with red heatshrink at both ends to indicate both active and neutral are potentially live. However, two-way circuits expose the unwary to a risk, especially when replacing a blown globe. Being two-way, you have no idea what position the switches should be to ensure the lamp is switched off.

I wonder how many people know about variant (a) as a method of wiring a two-way lamp circuit. As Andrew points out, it does have an advantage over the usual method, despite the need for four-core cable. However if the lamp is blown, neither circuit overcomes the problem of knowing the correct switch positions to turn the lamp off. Perhaps there's a future What?? question here!

### Input impedance

In November '97 I presented an op-amp question from Bryan Maher (author of *Op-Amps Explained*). Unfortunately the circuit had a mistake, so I presented the question



again in January 1998, along with a suggested answer for the question with the incorrect circuit (shown in Fig.4). My answer made the point that the input resistance of this circuit would depend on the supply voltage. And that's when the letters started...

I included one (from Damien Dunlop) in April, and in my answer pointed out that I had built a test circuit (with 10k resistors and a FET input 771 op-amp) to confirm my theory. But I think the problem lies with a definition of input impedance or, for a DC circuit (like this one), input resistance. My definition of input resistance is input signal voltage divided by the current taken from the signal source (input current). This letter disagrees:

*If the output voltage changes and the resistance is constant, then the current has to change. The input resistance is constant.*

*In a voltage divider, if the voltage across the two resistors is increased, the current through each will increase, but the impedance of the circuit is the same. (Darren Moore, Mt Waverley, Vic)*

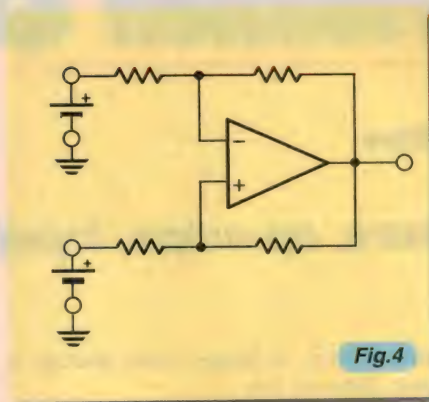
I interpret Darren's letter as suggesting that the input resistance to a DC circuit is constant, regardless of what else is happening in the circuit. I agree this is so under static conditions, which is what a DC circuit is all about. But if a DC value in the circuit changes from one static value to another, in this case the output voltage of the op-amp, then the input resistance to the circuit can also change.

In this case, because the resistive networks connect to a DC voltage that depends on the supply voltage, changing the supply voltage changes the DC conditions. Hence we get a change in input resistance. Otherwise Ohm's law doesn't hold. But:

*If the output voltage depends on the supply voltage, then the op-amp is obviously saturated against one supply rail, and is no longer a linear element. So this circuit is not, as you say, an example where a linear circuit has a variable input resistance, it's a convoluted example of Ohm's law and bridge theory. This general circuit arrangement can be found in most op-amp manuals as a Schmitt trigger or a squaring amp.*

*The input resistance at A or B is the incremental resistance  $dv/di$ , but  $dv$  here is not just the fixed battery voltage, as you seemed to have assumed. The bench supply is effectively in series opposition with both batteries, thanks to the saturated op-amp output stage. I bet that when you recompute the input resistance as  $d(V_{cc}-V_{bat})/di$ , it will turn out to be 20k at all values of  $V_{cc}$ .*

*The impedances should be even simpler: replace all DC sources with a short circuit, then (assuming the op-amp is saturated), again you have two resistors in series, so  $Z_{in}$  (A or B) is 2R, or 20k. More generally, the*



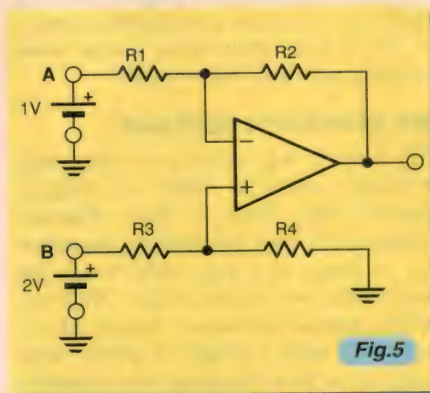
**Fig.4: The 'wrong' circuit for the op-amp question about finding the input resistance at A and B. Note all resistors are equal.**

actual impedance to ground from A or B would be near zero ohms, because of the two batteries. (Roly Roper, Elands NSW)

Let's take the last point first, Roly. The input resistance (impedance) to a circuit is the resistance (impedance) seen by the signal source (the 1V and 2V batteries). You don't leave the signal source connected when calculating input resistance, you disconnect it. Otherwise, you get a parallel resistance — the input resistance of the circuit in parallel with the resistance of the signal source. Never!

As for the op-amp being saturated, who cares? It's still producing a fixed DC output voltage. Change the supply voltage, and the fixed DC voltage changes to a new but static value, causing a change in the input current taken from the signal sources. The equation  $dv/di$  doesn't apply here, as we haven't changed the input signal voltage ( $v$ ), we've changed something in the circuit. I'm sure you'd agree that if we changed the values of the resistors, the input resistance would change. So what's the difference if we change a DC voltage in the circuit?

So that's a few comments on the *wrong*



**Fig.5: The right circuit for the op-amp question.**

circuit. Now to the right circuit (Fig.5)...

When I first saw the circuit diagram for January's What??, I thought you would probably come up with the wrong answer — a common occurrence with this circuit.

It is erroneous to assume that resistance is simply defined as  $V/I$ . A more precise definition is  $dV/dI$ , where  $d$  is a 'change in'. That is, resistance is equal to the ratio of the incremental change in voltage to the incremental change in current, with all other independent sources (voltage and current) held constant (often at zero). Fortunately this usually simplifies to  $V/I$ .

Convention has it that, unless otherwise specified, all sources in a circuit are considered independent, that is the output voltage of one voltage source is not related to any other source. Since you specified the sources as simply 1V and 2V, we must assume they are independent.

What this means for your circuit is that the input impedances for each input are those impedances obtained by analysing each input separately while the other input is earthed. The input resistance at A is simply  $R1$ , while at B it's  $R3 + R4$ . Unfortunately, this circuit outputs a voltage or current from A if there's a voltage at B. This tends to confuse many people. Trouble can also arise when the circuit is analysed with common mode and differential signals. After all, this circuit is simply a differential op-amp. (Phil Dennis, University of Sydney, NSW)

Yes Phil, it's a differential op-amp, but it's also still a simple DC circuit. Nothing more. If it had AC input signals I'd agree with you. But I think you're making more of the question than was intended.

The question simply asked for the input impedances (resistances) at both inputs of the circuit, not for a general circuit. If you disconnect one of the input sources and connect that input to ground, conditions change. But that was not the question. You simply had to find the input resistances for the circuit as shown, with both signal sources connected. An Ohm's law question, not a searching question on circuit theory. And some more comments:

I agree with your assertion that the 'input impedance to a circuit is the signal voltage divided by the input current', as long as the input impedance (resistance) is referenced to the same voltage as the input signal. This is clearly not the case here, as the input resistance is referenced to the positive supply (the op-amp output). In this case, the input current changes you observed on your practical circuit are accompanied by proportional changes across the input resistance. The input resistance does not change. (Les Grant, email)



Again I can't see where I'm wrong. All the DC voltages in this circuit are referenced to a common line (earth). If they weren't, the circuit would need to show this. Les had a bit more to say:

*Your conclusion in December, that the impedance is infinite because no current flows in R1, is incorrect. This is the first time I have heard of a linear resistor having an infinite value because no current is flowing in it! I hope Bryan Maher's book didn't make the same mistake. I suggest you look at National Semiconductor's AN-20, 'An Applications Guide to Op Amps'.*

I can't quite see how you've interpreted my assertions this way, Les. Obviously a resistor is a resistor, whether lying on the bench, or in a circuit. But when you have a circuit, the combined effect of the components is another matter. And this is what we're dealing with. Not single resistors, but a circuit that contains an op-amp and other components. It's the circuit input resistance we want, not the value of the resistors.

Anyway, that's probably enough on this circuit. Clearly some readers have read more into the question than was intended. It's easy to do, particularly if you look at such a question from an academic point of view. As an ex-academic I'm as guilty of this as anyone.

On a parting note, is the output of a logic gate an input when it's sinking current?

## Black box

This question (March '98) had a number of cells in series supplying current to a 'black box'. If identical cells were added, but the current didn't change, what was in the black box?

The answer was a short circuit, but a number of readers had other ideas. Quite a few readers suggested it could be an open circuit. Well, I dunno. An open circuit doesn't pass a current (by definition), so given there was a current flowing into the black box (according to the question) I can't agree!

But as EA's Graham Cattley suggests:

*An open circuit (nothing) is simpler than a short circuit. You might say if the voltage is high enough, the open circuit could arc. True, but what about a short circuit melting (to an open circuit!) if the current is high enough?*

Other suggestions included a constant current source, or a light globe. While either might be correct, the question asked for the simplest device. Of course as Jim Lowe (Heatherbrae, NSW) points out:

*OK, you threw me on the question, but who in their right mind would short circuit a battery? A lamp is better.*

I guess that's the advantage of a circuit on paper. You can pass as much current through the circuit as you like. But as Kees Lindeman (Alambie Heights, NSW) says:

*I'm willing to test your circuit if you can give me the resistance-free wire!*

## Ladders against walls

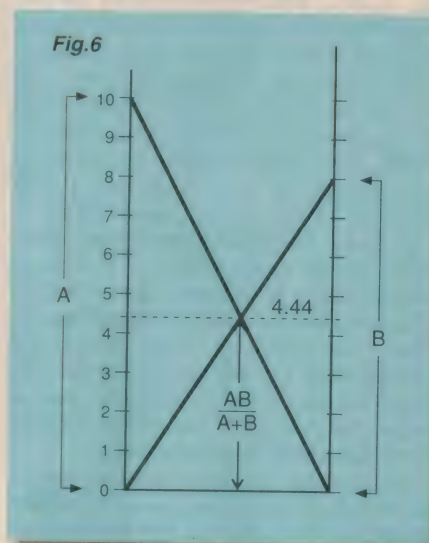
I received quite a few letters on this question (April '98), mainly sending a solution. Everyone agreed the question was more difficult than it looked, but one reader has pointed out something rather interesting:

*Now whose clever idea was it to put this question into an electronics magazine? Because what it says is that if the heights A and B represent resistors, then the height of the intersection represents their parallel combination. You could make a nomograph out of this, if anyone needed such aids in the day of calculators. (Robin Stokes, Armidale, NSW)*

Thanks for pointing this out, Robin. As you can see in Fig.6, the parallel combination of a 10Ω and an 8Ω resistor is 4.44Ω. Or, as a general case, the height of the intersection of the two lines is (AB)/(A+B).

On the question of difficulty, Bruce Howard (Collingswood, SA) says:

*Your two ladders question is probably*



**Fig.6: The April '98 What?? question is also a nomograph for finding the value of two parallel resistors...**

*more suited to a publication like Scientific American, rather than EA.*

You could be right Bruce, but going on our last letter, I'm not so sure.

*I know you have striven to present puzzles which serve to reinforce electronic theory. When you ran short of these, you presented some non-electronic puzzles, or rewrote them to give them an electronic feel. I sent you a few myself.*

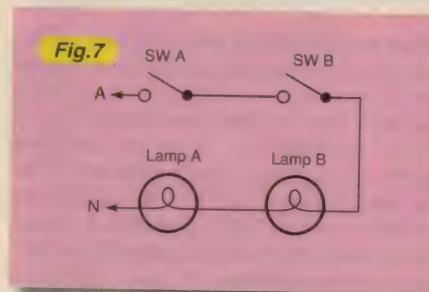
*I personally found these non-electronic puzzles more interesting, and in most cases more challenging, and I suspect others found likewise. I've found that anyone who has an interest in science or engineering enjoys mentally wrestling with a brain teaser puzzle. So don't worry, just keep this segment going. (Peter Stuart, South Windsor, NSW)*

That's all we have space for, so thanks to

you all for your letters. And yes, I sure intend to keep up the questions, and I'm sure you will keep me on my toes about the answers.

## What??

The question this month was sent by Bruce Howard (Collingswood, SA), and comes from *Mathematical Carnival* by Martin Gardner (who as I recall ran a column for many years in *Scientific American*). It's an electrical question that can be built as a circuit to mystify your friends:



**Fig.7: The circuit for this month's What?? question.**

The circuit, shown in Fig.7, comprises two conventional 240V lamps and two SPDT light switches in series. The circuit connects to 240V AC. Now here's the catch: When both switches are on, both lamps light. If one lamp is removed the other goes out, as you'd expect. But when switch A is on and B is off, only lamp A lights. And when switch B is on and A off, only lamp B lights. Even more inexplicable is the fact that if the two lamps are interchanged, switch A still controls lamp A and switch B controls lamp B. How is this done?

## Answer to June's What

The answer is three weighings. Call the 12 balls A to L and the odd ball X. First weigh ABCD against EFGH. If equal, X is in IJKL, so second weighing is IJK against ABC (normal balls). If equal, X = L, and weigh L against any other ball to determine if it's lighter or heavier (third weighing). If not equal, IJK must contain X and we know whether it's heavy or light, so weigh I against J for answer (third weighing).

If the weight of ABCD does not equal EFGH, note which group is heavier, and which is lighter. Replace FGH with JKL (normal balls) and swap A with E. Weigh EBCD against AJKL (second weighing). If same as before, BCD contains X and we know whether it's heavier or lighter. Weigh B against C for answer (third weighing).

If now equal, FGH contains X and we know whether it's heavier or lighter. Weigh F against G for answer (third weighing). If reversed, A or E must be X and we know if it's heavier or lighter. Weigh A against a normal ball for answer (third weighing). ♦



# Computer Clinic

## Windows Write, more IRQs, proxy servers & passwords

### More IRQs?

I have just installed a new Abit TX5 motherboard, but since the board has so many inbuilt extras it is occupying more IRQ channels than a lower end motherboard would normally do. It is an excellent board, giving super fast performance for the hard drive, video and RAM, but its limitation is the IRQ channels. I would like to know if it would be possible to add more IRQ channels? If not, why not? (Lachlan Dainton, by email)

In a word, no. The actual process of designing a system with more IRQs wouldn't be too difficult, but there would be one major drawback: virtually no existing software or hardware would work with it. This is just one more case of technological lock-in, like segmented addressing and VHS videotapes. Nobody likes these technologies, but we're stuck with them because there's already far too much money invested in them to drop everything and start again. Just remember the pain and misery caused when, back in 1981, some clever person at Microsoft decided that 640KB of RAM would be more than anyone could ever need...

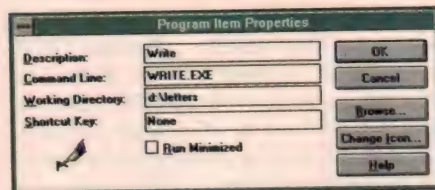
This is definitely going to become more and more of a problem over the years, and I really don't know what anyone's going to do about it. It will probably end up as yet another barely functional last-minute kludge like the expanded memory fiasco. All that will be required then will be another few hundred megahertz, double the RAM, and everything should limp along as usual. Ah well. If nothing else, I dare say it will keep this column going...

### The write stuff

I use Windows 3.1 and find the 'Notepad' and 'Write' programs that come with it normally sufficient for my needs. However, they have an annoying problem of always starting with default settings for the 'File' and 'Page/Document' options, etc. Is there anything I can do that will enable these two programs to start up with the file menu initially pointing to, say, the 'D:\LETTERS' directory and with my own ruler and page size specifications? (Roger Duke, by email)

Good news. Changing the default directory for load/save operations is dead simple. Here's what to do:

Select the Write icon in Program Manager, and go to File/Properties, or hit Alt-Enter.



This will bring up the 'Properties' dialog box that allows you to set the caption, command line, working directory and icon for the program. From here, just enter the name of your preferred starting directory (e.g. 'D:\LETTERS') into the 'Working directory' text box, and hit 'Ok'. Now when you run Write, the file requesters will start up in 'D:\LETTERS'. This approach works for just about any program in Win3.1x, so try it with Notepad, Paint, or anything else you like.

To change the default paper size and orientation (for all applications), go to Control Panel/Printers, and hit 'Setup'. This will bring up a dialog that looks and acts exactly like the Print Setup dialog in Write, except that changes made here get saved as default settings. Of course, being a Microsoft product, it doesn't tell you that it changes the defaults; that would smack too much of logic...

As for rulers and such, however, you're out of luck. Write is far too primitive to save information like this, so you just have to keep setting them every time.

### Two on the net

We have two computers connected as a simple Peer-to-Peer network, running Windows95. In an attempt to get better value for our Log-on hours, we would like to be able to run a browser on both computers simultaneously while logged on, (using Dial-Up Networking, to our ISP). Is this possible, and how? (Robert Backhaus, by email)

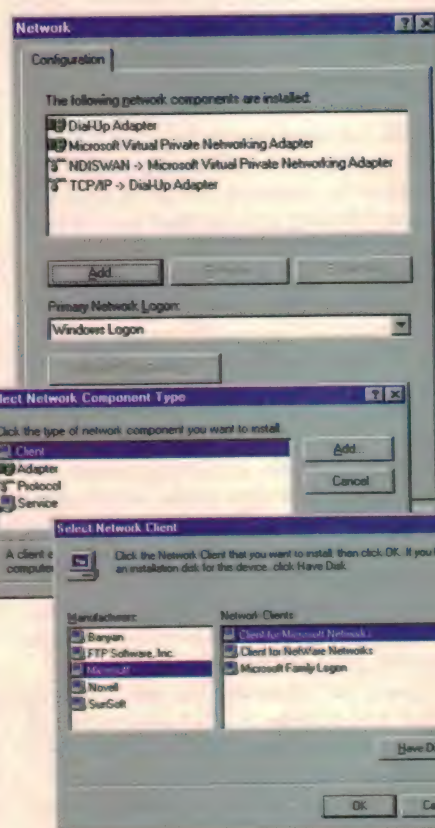
Yes you can, and it's quite straightforward. Although Win95 doesn't support this directly, there are a number of proxy servers out there that will do the job for you. The best deal I've found so far is VSOCKS Lite, a free-proxy server for Windows 95, available from <http://www.pscs.co.uk/software/vsocks-lite.html>. There are dozens of others available, but a lot of them are fairly expensive, with prices as high as \$4000! You'll need to be run-

ning TCP/IP on your LAN, but apart from that, it's a breeze. Setting up your LAN for TCP/IP is a little complicated to go into here, but there's a lot of useful information about this at <http://www.malch.com/twosys.html>. Once you have that set up, you install the proxy server on the computer with the modem, and set up the other computer to use it as its proxy server instead of the one provided by your ISP.

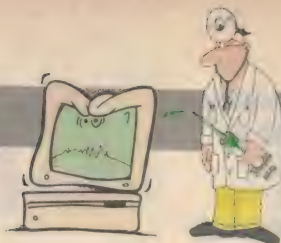
### Exploring passwords

Can you tell me how to 'fix' my Internet Explorer so that it does not ask me for my password every time I log on? I must have clicked the 'save password' box a hundred times now, but it does not seem to be getting closer to learning it. I would have thought that once would have done it if I were doing it correctly! (David and Lisa Wilmshurst, by email)

Simple as this may seem, and common as this problem may be, it's a little difficult to give you one single solution. Various factors conspire to complicate the issue, such as whether you have a network card, what ver-







sion of Internet Explorer and Dial-up Networking is installed on your system, and the state of your .pwl files. The problem is a strange one, hovering somewhere between being an all-out bug and just being the normal loony behaviour we've all come to expect from Windows.

I should point out before I start that enabling password caching requires a network client, and that installing one adds extra items to the desktop and various system menus, and the system will probably keep asking you for Windows passwords and such every time you boot. I personally find this more annoying than having the system fail to save my internet password, but your mileage may vary.

For the purposes of this demonstration, I'm assuming that you're not connected to a LAN. If you are, I suggest that you don't do any of this, as you could end up not being able to access your local network, which is much more annoying than having to type in your password every time...

Pushing ahead regardless, though (and working blind, so no rock-solid guarantees), I suggest the following procedure:

First ensure that you have Client for Microsoft Networks installed. To do this, go to Start|Settings|Control panel|Network, and have a look at the items in the list. If you don't see Client for Microsoft Networks, click on 'Add', then 'Client', 'Microsoft',

and then 'Client for Microsoft Networks'. It'll want you to insert your Win95 CD when you do this, so make sure you have it to hand.

Once it has finished whirring and chugging and flicking through bargraphs, keep hitting any buttons marked 'Ok', and the system should reboot. If not, you'll need to restart manually. When you do reboot, you should be greeted with a dialog box asking you to 'Identify yourself to Windows'. Enter a name (any name, it doesn't care) into the 'User name' box, but **leave the password box blank**. Another dialog box will appear, asking you to confirm your password, so just leave the boxes blank and hit 'Ok'. Theoretically, it should never ask you for a logon password again — but this is a Microsoft product, so don't count on it.

With any luck, the 'Save password' box should now work. (You will need to successfully connect once with the box ticked before it will save the password; if you cancel or fail to connect, the password probably won't get saved.)

If all the annoying networky bits get too much for you, go back to Start|Settings|Control panel|Network, select Client for Microsoft Networks, and hit 'Remove'. After a lot more whirring and chugging, the system should reboot and come back the way it was before.

That's about as far as I can go this month without seeing your system myself, so good luck! ♦

## A real C/C++ compiler.

DOS box



If you've ever done any programming on a PC, you have probably come up against some of the more unpleasant aspects of PC architecture, such as segmented addressing and the 640K barrier. These effectively conspire to make dealing with more than 64K of data difficult, if not impossible.

This isn't a problem if you're just writing simple software, but if you want to deal with more than 30K of integer variables, (as you really need to do if writing data logging software, for example) your program will most likely give you 'Out of memory' errors, no matter how much RAM you have. Even expensive commercial C++ compilers such as Borland's Turbo C++ tend to crash and die if an array crosses a segment. This is downright pathetic in this day and age, and Unix programmers tend to hoot and point when they see the contortions that we mere PC users go through, just to handle a table of data.

Luckily, there's a way round all this, and it's called DJGPP. DJGPP is an MS-DOS port of the Unix GNU C/C++ compiler, and gives you access to 32-bit, 4GB flat address space and up to 256MB of virtual memory. It runs on just about anything from a 386SX upwards, and under just about any OS from plain ol' DOS up to Windows NT. It comes with some amazingly powerful graphics and I/O libraries, and even a 3D graphics rendering engine. It also has an excellent editor and development environment, bearing a striking resemblance to the Turbo C++ IDE.

With all these features, how much would you expect to pay? If you said 'Nothing!', you're absolutely right. With a few exceptions (notably, some of the C++ class libraries), DJGPP is completely free — which makes it ideal for developing free and commercial software alike. And if you're thinking that a freeware compiler can't be terribly powerful, just ask ID software, who used DJGPP to write a little game they called 'Quake'...

DJGPP is available from <http://www.delorie.com>.

Got any computer queries? Whatever is bugging you, from hardware problems to C programming, send it in and we'll soon have you fixed up. You can email your question to [electaus@magna.com.au](mailto:electaus@magna.com.au), or fax or mail it in to us here at EA.

## THE TIGER COMES TO AUSTRALIA

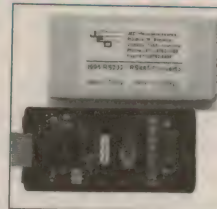
You've seen the BASIC Tiger and Tiny Tiger advertised in the US magazines: they are now available in Australia from JED.



Tigers are modules running true complied (not tokenised), Multitasking BASIC at 20 Mhz, but only draw 45mA. They have memory, 4 x 10-bit analog inputs, digital I/O, two serial ports, RTC, and are superb small controllers for scientific and industrial applications. **A Tiger with 128kB FLASH, 128kB CMOS RAM and RT clock costs only \$145.** A development system (W95), with a proto board, is only \$245. JED has a local board/controller with LCD/Kbd and industrial I/O.

See our [www](http://www.jedmicro.com.au) site or call for data sheets.

### RS232 to RS485 Converter



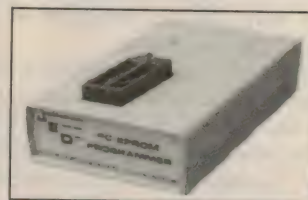
The small plastic case 100mm by 55mm by 25mm is an Australian-built RS232 to RS485 optoisolated converter. It connects a PC or PLC RS232 serial port to a multidrop RS485 differential cable up to 4,000 ft long.

The J995A converter has an internal microprocessor to automatically connect the transmitter to line, so the user program need not use the RTS line for RS485 TX control.

Cost \$160 plus \$20 plug pack.

### \$300 PC-PROM Programmer Also: \$145 Eraser with timer.

This programmer plugs into a PC printer port and reads, writes and edits any 28-pin or 32-pin PROM without needing special plug-in cards.



**JED Microprocessors Pty Ltd**  
[www.jedmicro.com.au](http://www.jedmicro.com.au)

173 Boronia Road, Boronia, 3155

Ph 03 9762 3588

Fax 03 9762 5499

(prices do not include freight or sales tax.)



*Electronics Australia* is one of the longest-running technical magazines in the world. We started as *Wireless Weekly* in August 1922 and became *Radio and Hobbies in Australia* in April 1939. The title was changed to *Radio, Television and Hobbies* in February 1955 and finally, to *Electronics Australia* in April 1965. Here's some interesting items from past issues:

## 50 years ago

### July 1948

**Compact Projector for Home Television:** A recent adaptation of the Schmidt optical system permits the design of a compact projection box using a 2.5" cathode-ray tube, giving a 12" x 16" picture. The novel corrective lens is made from gelatine sealed between glass plates, while the power is derived from a 25kV voltage tripling supply.

The initial image is formed on the screen of the 2.5" diameter tube, which has been shown to be the minimum practical size. Magnetic focus and deflection, the moderate deflection angle and an acceleration potential of 25kV permits the design of an electron gun producing a 0.003" diameter spot at the tube face. This permits adequate resolution of a 525-line image when optically magnified to produce the 12" x 16" projected picture.

**Cosmic & Solar Radio Noise Analysis:** Scientists of the US Standards Bureau are initiating a project for the observation and analysis of radio noise generated by the sun, a companion project to cosmic radio noise studies already in progress. Two 25-foot radar dishes at the Bureau's radio propagation laboratory at Sterling, Va will intercept and record solar noise reaching the earth.

## 25 years ago

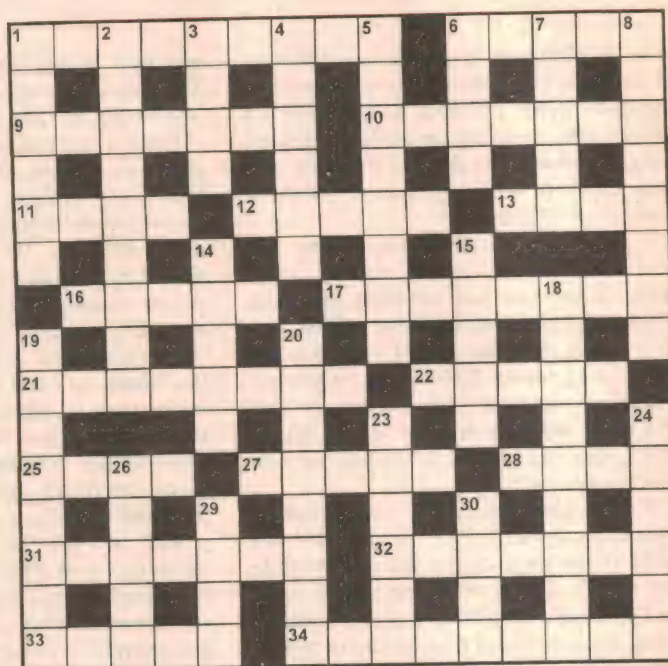
### July 1973

**Optical Communications Getting Closer:** Two new developments in the field of fibre-optics seem likely to trigger renewed interest in the use of optical carriers for communications. A new single-material optical fibre with losses as low as 5dB per kilometre has been announced by Bell Laboratories, while Corning Glass reported the development of a core-cladding fibre with a loss of only 2dB per kilometre at a recent meeting of the American Ceramic Society.

Bell Labs have also announced a second development which brings optical communications closer to reality. A new semiconductor laser developed at Bell Labs has been operating continuously for more than three months, and from batteries — showing that the required reliable light source can now be produced. The new laser is a semiconductor chip the size of a pinhead, and operates at room temperatures. Modulation capability is in the region of six megabits per second.

**Minicomputer Breaks the 'Kilobuck' Barrier:** Computer Automation Inc of California has released a new version of their 16-bit Naked Mini computer. Using LSI integrated circuits, it is built on a single printed board only 381 x 429 x 28mm, including 4k of core memory, and sells for \$990 in 200-up quantities. ♦

# Crossword



### Across

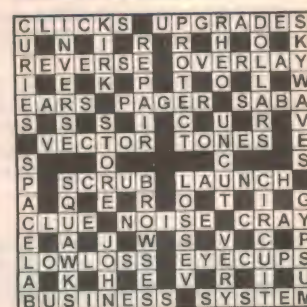
- 1 Measuring instrument. (9)
- 6 Restore to original status. (5)
- 9 Pulsing of the heart. (7)
- 10 Device for holding small microphone. (3-4)
- 11 Instruction in radiotelephony. (4)
- 12 Constellation of Rigel. (5)
- 13 Network. (4)
- 16 Picture element. (5)
- 17 Molecular property of nitrogen. (8)
- 21 Said of certain filters. (4-4)
- 22 Magnetic unit named after mathematician. (5)
- 25 Name associated with speed. (4)
- 27 Radioactive gas. (5)
- 28 List of contents or options. (4)
- 31 Water wave. (7)
- 32 Number. (7)
- 33 Research and development. (1,3,1)
- 34 Frequency of a billion cycles per second. (9)

- 5 Using an after-market add-on. (8)
- 6 Part of 8-down. (4)
- 7 Type of eclipse. (5)
- 8 Home entertainment unit. (4,4)
- 14 Pace of music. (5)
- 15 Said of interfering fields. (5)
- 18 Thing or person delivering information. (9)
- 19 Instrument for measuring resistance. (8)
- 20 Leaving gravitational pull. (8)
- 23 Following a radio signal. (6)
- 24 Crystalline substance. (6)
- 26 Telecoms jargon for change of network. (5)
- 29 Interval in the frequency spectrum. (4)
- 30 Reduce by means of chemical action. (4) ♦

### Down

- 1 Spacecraft of cosmonaut Gagarin. (6)
- 2 Attending to sound. (9)
- 3 Subatomic particle. (4)
- 4 Supposed explanation of phenomenon. (6)

### June's solution:





# Electronics Australia's **Professional Electronics**

UNSW scientists develop  
fibre-optic phase modulator  
operating at up to 1Gb/s

Review of Adaptec's Easy CD  
Creator Deluxe software for  
'burning' your own CD's

Batteries Feature:  
How to charge Li-Ion cells  
and batteries correctly

New additive boosts power  
and life of lead-acid batteries



**Vote of confidence:** Saudi Arabia's HRH Prince Alwaleed Bin Talal Bin AbdulAziz Alsaud (centre left) invests US\$200M in the Teledesic 'Internet In The Sky' vision of global broadband communications, watched by Teledesic's Chairman & CEO Craig McCaw (centre right)



# h i g h l i g h t s News

## UNSW scientists develop 1Gb/s optical modulator

A subtle approach to coating a thin film around an optical fibre has allowed a group of surface scientists at the University of New South Wales to construct a fibre-optic modulator capable of producing 100% phase modulation at up to one gigabit per second.

The secret of their success was to use only about one two-hundredth of the energy used by competing groups to coat a 0.5µm film of zinc oxide around the fibre. This also produced a highly uniform film around the fibre, which delivered further advantages.

But why would anyone want to put a thin film of zinc oxide around an optical fibre? The answer is that zinc oxide is a piezoelectric material. This means it will expand or shrink if a voltage is applied to it (or will produce a voltage when squeezed, which means it can also be used for pressure sensors).

In this case, the film of zinc oxide coated around the fibre is connected to two metallic contacts. When a voltage is passed through the zinc oxide coating, the coating contracts. As the coating is concentric with the centre of the fibre, this contraction causes a shock wave to pass through the fibre, so the contractions from all parts of the zinc oxide coating arrive at the core at the same time.

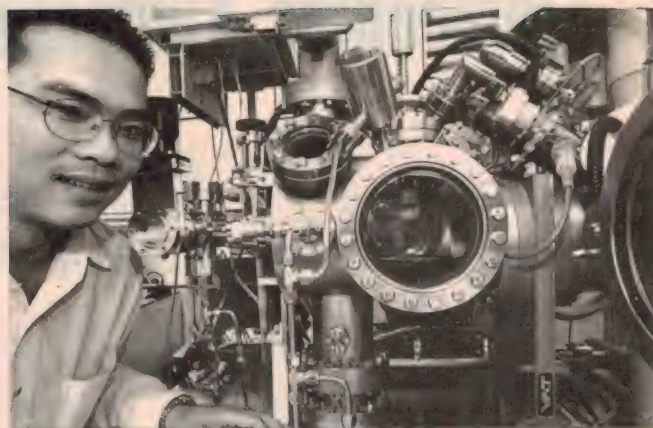
By squeezing the optical fibre in this way the *phase* of the light travelling through it can be changed, producing effective phase modulation of the light in response to the electrical signal applied to the ZnO film. And if you have a device that can modulate in this way at up to 1GB/s, you have a device in which the global communications industry should be very interested.

The breakthrough in the novel application of the technology was made by Professor Robert Lamb, Dr Leong Mar, Dr Michael Koch and Dr Peter Timbrell at UNSW's Surface Science and Technology Centre, and its performance was measured in collaboration with a researcher at the University of Sydney, Dr Mark Janos.

The breakthrough enables the device to perform 100% light modulation (phase shift induced). Currently, similar devices can achieve no more than 50% modulation.

The Australian Photonics Co-operative Research Centre at the Australian Technology Park now plans to develop and market the device. The Chief Executive Officer of the Centre, Dr Mark Sceats, said "The key ideas have been patented, so now is an appropriate time to look for commercial developers of what should be a very saleable product."

"Optoelectronic and photonics engineers have long known of zinc



oxide's superior piezoelectric properties, but this is one of the first times we have been able to maximise its performance. A modulator operating at one gigabit per second is very impressive. By using special fibres, we can extend the bandwidth by a factor of two, which makes the technology very attractive to new networks being developed for digital applications", Dr Sceats added.

## ADF leasing ex-US Navy satellite

In what is claimed as a unique arrangement involving Hughes Global Services, PanAmSat Corp. and the Australian Defence Force, a Hughes-built communications satellite formerly used by the US Navy is providing the ADF with new communications services. Under a multimillion dollar contract to Hughes Global Services from the RAN, Leasat 5 began service on May 7.

Leasat 5 will provide UHF satellite-communications services to the ADF for five years, if all options are exercised. To provide service to Australia, the satellite had to be relocated from its original position over the Indian Ocean to its new position of 156° East longitude. Hughes led the effort, working with a number of US government and international agencies, as well as the ADF, to obtain the necessary approvals for satellite relocation and frequency use.

Hughes has worked in conjunction with Leasat 5's owner, PanAmSat, to meet the UHF satellite-communications needs of the

ADF. PanAmSat owns and operates the satellite and is providing satellite capacity to Hughes Global Services. PanAmSat will monitor and control the spacecraft's attitude and orbital position via tracking, telemetry and control, and will also monitor and control Leasat 5's communications payload.

"This satellite was literally within days of being propelled into useless orbit, since its service to the US Department of Defense had been completed", said Ronald V. Swanson, president of Hughes Global Services. "Because we have three decades of experience as a government contractor, we were able to expedite the US Government

approval for the relocation and operation of Leasat 5 on behalf of our customer, the Royal Australian Navy. It's a win-win situation, and exemplifies how Hughes Global Services operates", Swanson said.



**The University of Sydney's School of Mechanical Engineering has installed an array of 28 Digital Equipment Alpha workstations, to achieve supercomputer performance at a fraction of the price. Pictured is Professor Nhan Phan-Thien with the array.**



The communications payload of Leasat 5 consists of two large helical UHF antennas, providing receive and transmit capability in the UHF band (240 to 400MHz). Telemetry, command and Fleet Broadcast uplink and beacon are in the 'exclusive' portions of the SHF band (7250 - 7500MHz and 7975 - 8025MHz). Twelve UHF repeaters provide the main communications capability.

## Intel's new fab in Ireland, factory in China

Intel Corporation has officially opened the first 0.25um microprocessor production factory in Europe. Located in Leixlip, Ireland (just outside Dublin) the new 800,000 square foot factory, called Fab 14, will produce advanced microprocessors — such as the Pentium II, Pentium II Xeon, and Celeron processors — for the worldwide computer market.

Fab 14 cost US\$1.3 billion to build and equip. The company has also announced that it will convert Fab 10 (next to the new factory) to the 0.25um process technology next year, at a cost of several hundred million dollars.

"Intel's ability to seamlessly ramp 0.25 micron process technology into full production has allowed us to bring higher performance microprocessors to customers at lower relative costs than any other time in history," said Craig Barrett, Intel president and COO. "Intel will convert its entire microprocessor production to 0.25 micron technology by the beginning of the fourth quarter of this year. Ireland will play an important role in that conversion."

Ireland's Fab 14 joins three other Intel factories, D2 in California, Fab 11 in New Mexico and Fab 12 in Arizona, in building advanced microprocessors using Intel's 0.25um process technology. Fab 14 has brought Intel Ireland's current employment count to over 4000 people, of which over 95% are from the local region and brought Intel's total investment in the country to over US\$2 billion.

Intel Chairman Dr Andrew S. Grove has also opened the company's first manufacturing site in the People's Republic of China, in Pudong, Shanghai. The factory assembles and tests flash memory products, which are used in PCs and consumer electronic devices such as mobile telephones and digital cameras. According to leading industry research firm Dataquest, Intel is the world's largest supplier of flash memory.

Dr Grove said "This is an important milestone in Intel's history in China. This facility will be a major flash memory producer for the worldwide market. We're striving to make the facility a cost, delivery, quality, environmental and health and safety leader in the industry. We're committed to China, and delighted to be playing a role in the development of Shanghai's flourishing manufacturing economy," he said.

Intel's investment at the Shanghai site totals US\$198 million. Construction at the site started in December 1996 and was complet-



*To house a remote weather watch radar installation it installed in New Caledonia for Meteo France, the Australian Bureau of Meteorology chose a James Hardie 'Ausco' equipment shelter. It worked so well that ABM has adopted it as a new standard for similar installations around Australia.*

ed in September 1997, three months ahead of schedule. The facility went into production in January 1998, four months ahead of schedule. The factory employs about 400 people, with plans to hire another 100 people by the end of this year as production volume increases.

Intel also recently announced that it will open an information technology R&D centre in Beijing, the Intel China Research Center, and expects to invest US\$50 million during the next five years to fund the new organisation. The Center will report to Intel Fellow Dr Richard Wirt, director of the company's Microcomputer Labs.

## HP Infinium scopes win US Navy contract

The US Navy has signed a multi-million dollar contract with Hewlett-Packard to purchase the company's Infinium high-performance digital oscilloscopes. Under the agreement, HP will supply the US Navy's Inventory Control Point (NAVICP) in Mechanicsburg, Pa., with a potential quantity of 5000 HP 54825A Infinium scopes over five years. NAVICP is responsible for managing the Navy's inventory of spare parts for ships and their systems.

"The Infinium scope was successfully evaluated under extensive environmental testing to assess its ability to stand up to the rigors of military duty", said Mike Gasparian, general manager of HP's Electronic Measurements Division. "The ease-of-use aspects of the HP Infinium scope, with its direct-access controls and Windows operating system, will allow the US Navy to focus on personnel training — not on test-equipment training."

The HP 54825A Infinium oscilloscope — one of five HP Infinium family scopes — was developed for the commercial, off-



*Texas chipmaker Dallas Semiconductor supplies the Crypto Button, a Java-based hardware ID token in a steel case. It's used in the new Java Ring, used for personnel ID.*



the-shelf marketplace. It was designed to be easy to use and to lessen user frustrations with the complexities of oscilloscopes. Despite its very high performance, the 500MHz scope's simple, analog-like front panel, Microsoft Windows-based graphical user interface and built-in information system make its high-performance features accessible, uncomplicated and easy to use.

In a related contract signed in December 1997, NAVICP agreed to purchase a potential quantity of 1000 HP 54645A mixed-signal, dual-channel oscilloscopes over three years with an option to extend the contract by two years.

## Protel opens office in Hamamatsu, Japan

Protel International, the Australia-based developer of Windows-based electronic design software, has announced the expansion of its Worldwide Direct Network with the establishment of Protel Japan in Hamamatsu, Japan. The Worldwide Direct Network was launched earlier this year as part of Protel's commitment to providing designers the opportunity to benefit from powerful design tools, regardless of location or level of funding.

Protel says the development will allow it to maintain tight control over affordability and ease of access to its powerful design tools for Japanese electronic designers.

"The philosophy behind Protel's Worldwide Direct Network is a belief that all designers must be able to access the best electronic design tools if the industry is to continue seeing great innovation and advancement", explains Nick Martin, Protel's founder and CEO. "One factor which may have prevented this for designers in many regions in the world is price. Although most agree that the world should now be considered a single market, the EDA industry has been slow to respond and has maintained highly variable pricing of certain products in different economies."

"Protel International has addressed this issue through the establishment of the Worldwide Direct Network, to offer products at a single price directly to designers in many different regions. We are very pleased to be able to extend this network to Japan, a region which currently contributes significantly to our revenues and we believe still has a lot of room for growth."

Mr Teruyuki Washizu has been appointed President of Protel Japan. Mr Washizu has extensive experience in the sales and marketing of technology, including close to a decade supplying software to the electronics industry. In 1989 he founded his own PCB design company, which became involved in the supply of electronic design software, including Protel products from 1993.



**HRH The Prince of Wales recently presented UK digital video processing specialists Snell & Wilcox with a Queen's Award for Technology, for their Alchemist PhC Motion Compensated Standards Converter.**

## EnergyAustralia to build IT 'super corridor'

Power utility EnergyAustralia has announced a high-tech initiative which it claims will take New South Wales to the forefront of the information technology revolution. It is proposing to build a high speed photonic 'super corridor', implemented using slender fibreoptic cables supported by its existing power poles.

The 'super corridor' will initially link major NSW universities and the Australian Technology Park (ATP) in Redfern. EnergyAustralia offices in Sydney and Newcastle will also connect to the system. The project will incorporate high performance computing facilities, to be based at ATP, with a 'node' near the University of Newcastle. Because the super corridor will be able to deliver information at 1GB/s, one supercomputer will be able to service the needs of a number of sites.

"We believe photonics will be the next wave in information transfer technology", said EnergyAustralia MD Mr Paul Broad. "It will enable information to be sent at high speeds and very high volumes. This potentially represents major benefits for research and development in the universities, and for industry, commerce and business in Australia."

## Japanese firms announce blue lasers

Two Japanese firms, Nichia Chemical and Matsushita Electric, have announced the development of blue-violet semiconductor lasers with the potential to extend the data storage capacity of DVD and other optical storage media by up to 2.5 times. This will allow a single-sided 120mm DVD disc to store up to 15GB of data, or six hours of video program material.

The laser diode developed by Nichia Chemical is based on gallium nitride material, and produces light directly at a wavelength of about 410nm. That produced by Matsushita is of the hybrid second-harmonic generation (SHG) type, where a laser producing infra-red light

## IN BRIEF

- Leading frequency control product manufacturer **Hy-Q International (Australia)** have signed a sole agency agreement within Australia, New Zealand and Asia Pacific with Mercury Electronic Industries, for the supply of quartz crystal products. Mercury has offices in Taiwan, the Philippines and the United States, and are an innovative designer and manufacturer of an extensive range of high quality quartz products.
- **MANUfesto '98**, a convention/show designed to bring the worlds of science, research, industry and manufacturing together for mutual benefit, will be held at the Melbourne

Convention Centre from Wednesday 23rd to Friday 25th September 1998. More information is available from Julian White, on (02) 9490 8201 or by email at [julian.white@exec.csiro.au](mailto:julian.white@exec.csiro.au).

- Sydney-based mobile data communications specialist **United Wireless** has appointed Queensland company Barcode Products as an authorised network reseller. This will allow Barcode Products to further enhance its wireless data tracking of parcels for courier companies, using the Symbol handheld scanning device technology.
- Battery and power systems specialist **BTR Power Systems** (formerly Hawker Energy and Exide Electronics) has appointed Michael Mallia as



at 850nm feeds a nonlinear optical waveguide crystal which converts a percentage to the second harmonic at 425nm.

Both devices produce between 20mW and 30mW of output, which is sufficient to allow writing data onto optical discs as well as reading it. This means they will make possible a new generation of rewritable DVD drives for computers, and DVD-based digital video recorders to replace the domestic VCR.

## NZ system tailors hall acoustics

Technology developed in New Zealand, which could vastly improve the sound quality and flexibility of performance halls worldwide, has recently been licensed to a US company for manufacture. The new assisted reverberation system was developed by Industrial Research Limited in Wellington and is licensed to Level Control Systems for exclusive manufacture under worldwide licence.

Scientist Mark Poletti developed the reverberation system to electronically enhance the acoustics of a room. "When you have a concert hall you've got to have more than one use for it so it pays its way. One night it might be a lecture, the next a classical concert and the next a live show," he said. "Each different use requires different acoustics — ranging from speech which needs a short reverberation time of 0.5 to one second for good intelligibility, to music requiring a longer reverberation time of about two seconds. That's a huge range of reverberation time. To get that range out of a performance hall you have to use mechanical methods such as pulling curtains, moving panels and opening or closing adjoining rooms."

Using Poletti's assisted reverberation system the acoustics of a room can be adjusted electronically to produce high quality sound. Unlike most other current systems which just mike the performers in what is known as an in-line setup, the new non-in-line system has microphones suspended all around the room to capture sound. A multichannel reverberation unit is placed between the microphones and the loudspeakers. The sound is passed through a digital reverberator, which simulates

another 'room' and feeds the modified signals back into the performance room through loudspeakers. The whole process can electronically change the reverberation time and increase the apparent size of the room to improve sound quality.

A feature of the system is the natural two-way interaction which the system gives between performers and audience, as occurs in a 'natural' room.

Victoria University's School of Music has a prototype system installed in the Adam Concert room using 16 microphones and speakers. It was recently demonstrated to a team of acousticians, who were impressed by the system's sound quality and wide range of adjustment options.

Costs for the new sound system are similar to those for traditional in-line sound systems, and the first product made by Level Control Systems should be available later this year.

More information is available from Mark Poletti, Industrial Research Ltd, Wellington NZ; phone 04-569 0000.

## Single-chip HDTV MPEG-2 decoder

SGS-Thomson Microelectronics, a world leader in MPEG decoder technology, has announced a new decoder chip which is claimed to meet the challenging demands of high definition television (HDTV). The STi7000 is claimed as the first device to integrate an MP@HL MPEG-2 decoder, with advanced display and format converter, onto a single chip. Proprietary memory reduction technology ensures a cost-effective solution by allowing full HDTV pictures to be decoded and displayed using only 64 megabits of external memory.

Supporting all of the 18 video formats defined by the Advanced Television Systems Committee (ATSC) and Grand Alliance specifications, the STi7000 supports video rates up to 1920 x 1088 x 30Hz interlaced or 1280 x 720 x 60Hz progressive scan, and is also suitable for subsets of these standards such as HD0.

Designed for use in HDTV and other digital TV receivers and set-top boxes, the STi7000 was developed in collaboration with Thomson Multimedia, a strategic partner with whom SGS-Thomson shares a joint design centre in Grenoble, France. ♦

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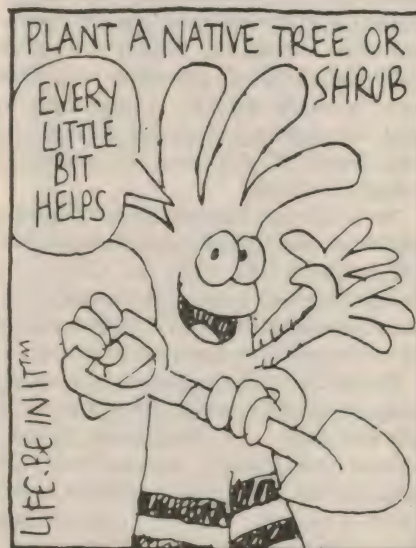
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its sales and marketing manager. Mr Mallia has joined the company from its competitor Chloride Power Electronics.

- PC card and CardBus communications product manufacturer **Xircor Australia** has appointed Electronic Resources (NZ) Ltd as a distributor in New Zealand. Electronic Resources will distribute Xircor's range of mobile computer connectivity solutions, including the recently introduced Xircor RealPort Integrated PC Card.
- DSP-based digital audio processor chip specialist **Medianix**, of Mountain View in California, has appointed Jerry Suhr as Director of Asia-Pacific Sales. The company has also completed sales agreements with representative firms Jetronic Technology of Hong Kong, I&C Microsystems of Seoul, Korea, MaxMega Electronics of Singapore and New Mercury Industrial Corp of Taipei. ♦

READER INFO NO.22

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# New Products



## Handheld calibrators

Two new hand held calibrators have been introduced by Yokogawa for use in the maintenance of industrial process instrumentation. Called the 'Handy Cal', both units feature simple operation with high basic accuracy (0.05%), a large easy to read five-digit liquid crystal display and auto power off after about 10 minutes to conserve batteries.

The CA11 is a Voltage/Current Calibrator capable of sourcing and measuring up to 30V DC or 24mA DC, while the CA12 is a Temperature Calibrator which can output signals equivalent to six types of thermocouples as well as resistance thermometer sensors.

On the CA11, the output can be changed from 4 to 20mA in 4mA steps or 1 to 5V in one-volt steps — or alternatively, the output can be increased or decreased at a constant rate for a selected sweep time, either 16 or 32 seconds. The CA11 can also sink up to 24mA from an external power supply, making it easy for the operator to per-

form loop checks.

Thermocouples able to be simulated by or measured with the CA12 Temperature Calibrator include types K, E, J, T, N and R as well as PT100 resistance temperature sensors. When generating thermocouple signals a built-in sensor for reference junction compensation provides high accuracy. For even more precise compensation an external RJC sensor is optionally available.

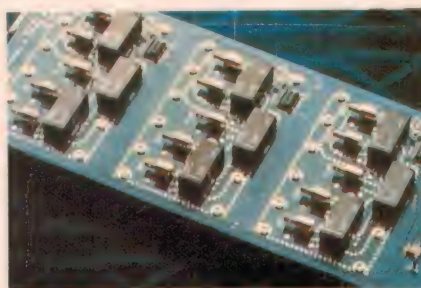
Both units run on easily obtainable 1.5V AA-size batteries, giving up to 50 hours battery life. They can also be operated from a separately available AC plug-pack adaptor.

For more information circle 241 on the reader service card or contact Yokogawa Australia, Centrecourt D1-D2, 25-27 Paul Street North, North Ryde 2113.

## Wideband switching card for 75Ω systems

The Keithley Instruments Model 7038 is a 2GHz, 75Ω multiplexer card for its 7001 and 7002 switching mainframes. It's claimed to be the most compact switch card available, containing three independent 1x4 multiplexers and also allows the three switch banks to be interconnected to form a larger 1x8 or 1x10 configuration. This flexibility allows users to configure complex test set-ups and achieve higher test system throughput.

The ultra-wide bandwidth relays used in the Model 7038 provide low insertion loss and high isolation for DC to 2GHz signal switching. There is less than 3.0dB loss at 2GHz in each of the signal paths. The relays have less than 1Ω contact resistance over their life and are engineered to withstand up to 5,000,000 dry contact switch closures. With actuation time of less than 6ms and a power rating of 10W at 1.2GHz, they are well suited for the needs of high speed production test applications.



For more information circle 242 on the reader service card or contact distributor Scientific Devices Australia, 118 Atkinson Street, Oakleigh 3166.

## Mixed-value resistor networks

BI Technologies has claimed a major breakthrough in thick film technology with its resistor networks featuring different resistor values in the same package. This allows manufacturers to combine up to nine discrete resistance values in a small size package, eliminating eight discrete component placements. The networks can have a resistance tolerance of 1% and a ratio tolerance of 1%.

Two sizes of the resistor networks are available, 1206 and 2512. In the 1206, BI can integrate four isolated resistors and print two films. The resistance ratio is 2:1. For example, if one film is used, the resistance values that can be achieved are 1kΩ and 2kΩ. Using two films allows a different set of values with a different 2:1 ratio, such as 100kΩ and 200kΩ.

In the 2512 size, BI can integrate five isolated or nine bussed resistors and print two films. The resistance ratio is 4:1.

Applications for the custom arrays include R/2R ladder networks, current sink ladders for A/D converters, voltage dividers, and generally reducing board real estate and component count.

For more information circle 244 on the reader service card or contact distributor BBS Electronics Australia, Unit 24, 5-7 Anella Avenue, Castle Hill 2154.

## 64kb/s narrow band digital radio link

Trio Communications 2000 has released a complimentary digital radio capable of full duplex 64kb/s point to point connectivity in the 800/900MHz Fixed Data Services band. Using bandwidth efficient 16QAM modulation, the RAN65/25 fits a full 64kb/s into a normal 25kHz radio channel.

Unlike similar products available in the market, the RAN64/25 operates in the professional licensed communications spectrum, offering the user the utmost protection and reliability. Little effected by rain and fog, the RAN64/25





is capable of repeater use up to seven or so hops depending on software and application constraints.

Various synchronous interfaces are available such as V.35, G703 or RS-232/V.28, providing the user with a cost effective alternative to ISDN or hard wired alternatives. Optional multiplexer equipment allows up to six voice channels and a mix of fax and data. Directional Yagi antennas are used to ensure the most rugged link path, which can extend more than 30km depending on the terrain and link availability requirements.

For more information circle 243 on the reader service card or contact Trio Communications 2000, 41 Aster Ave, Carrum Downs 3201.

### Ferroresonant PSU

The CVT series of ferroresonant power supplies from Power Supplies Australia offer a constant-voltage, high-current DC output that can withstand extreme overload conditions, including a permanent short circuit.

Based on a large ferromagnetic-cored power transformer, the saturated magnetic field resonance in its secondary circuit produces a virtually constant AC voltage over the full output load range. The ferroresonant effect also maintains the output level over a +/-20% input voltage range, making the supplies ideal for powering PLC systems, charging battery banks and running security systems.

The CVT series can handle mains surges of 55% and input transients of over 2000V,

have an electrostatic shield between the primary and secondary windings, and don't need protection fuses thanks to the 'foldback' limiting effect of the ferroresonant system. Australian built and featuring a rugged chassis construction with stainless steel cover plates, the units also come with a seven-year warranty and are available in a wide range of voltage, current and power capabilities.

For more information on the CVT ferroresonant regulated power supplies or PSA's mains Line Conditioner units, circle 245 on the reader service card or contact Power Supplies Australia, 67 Handley Crescent, Dandenong 3175. ♦



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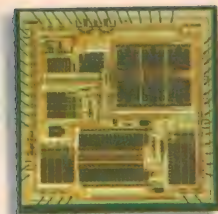
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# Solid State *Update*



Keeping you informed on the latest developments in semiconductor technology



## Low power quad 12-bit A-D converter

Burr-Brown's new ADS7841 is a four channel 12-bit sampling analog-to-digital converter (ADC) with a synchronous serial interface. Improved performance over existing solutions, low power consumption and single-supply operation of 2.7V to 5V make it well suited for battery-operated systems — <2mW at 2.7V supply!

In applications where low power is critical, the ADS7841's power-down mode reduces supply current to less than 3uA. This, in combination with high speed (200kHz sampling rate) and an on-board multiplexer, is said to make it ideal for industrial process control, remote data acquisition, test and measurement, medical instrumentation, and battery-operated systems such as personal digital assistants (PDAs) and multi-channel data loggers.

Features of the device include easy SSI/SPI serial interface, low power operation (3mW at 200kHz data rate), and small packaging. By using a serial input port, the ADS7841 can be configured as a four channel ADC with single-ended inputs or as a two channel ADC with differential inputs. Output can be software programmable for 8- or 12-bit resolution and the reference voltage can be varied from 0.1V to +Vcc.

For more information circle 271 on the reader service card or contact Kenelec, 2 Apollo Court, Blackburn 3130.

## 8-bit S&H ADC samples at 32MS/s

Analog Devices Inc. has introduced the monolithic AD9280, a single-supply, 8-bit, 32MS/s analog to digital converter (ADC) with an on-chip sample-and-hold amplifier and voltage reference. This makes the device

well suited for low-power operation in high-speed portable applications, as it can operate with a power supply ranging from 2.7 to 5.5V, using only 95mW on a 3V supply — including power for the reference. In addition, the device uses a multi-stage differential pipeline architecture at 32MS/s data rates and guarantees no missing codes over the full operating temperature range. The differential nonlinearity is a low 0.5LSB.

The user can select a variety of input ranges and offsets and can drive the input in either single ended or differential modes. The versatile sample-and-hold amplifier is equally suited for both multiplexed systems that switch



full-scale voltage levels in successive channels and sampling single-channel inputs at frequencies up to and beyond the Nyquist rate, — i.e. sampling at least 2x per frequency cycle.

The onboard reference is programmable, and a single clock input is used to control all internal conversion cycles. The digital output data is presented in straight binary output format.

For more information circle 273 on the reader service card or contact Analog Devices, PO Box 2098, Rosebud Plaza 3939.

## Synchronous buck controller IC

Siliconix has released what it claims is the industry's first synchronous buck controller IC to provide automatic true current sharing between parallel power supplies. The new Si9143CG is designed for point-of-use DC-DC conversion in high-performance servers and desktop computers, where its current sharing capability will reduce the stress on power supply components and increase system reliability.

Based on a new, patent-pending concept in current sharing, the Si9143CG allows the duty cycles of multiple controllers to be made

identical by tying together the PWM and SYNC pins of each device. The SYNC pin forces all of the controllers to start their duty cycles at the same time, while the PWM pin forces them to finish their duty cycles at the same time. As a result, all linked controllers will run at the same frequency and phase, and can thus run from the same power source and deliver power to the same output bus.

The Si9143CG solves a common problem in point-of-use power conversion in servers and high-end desktops, where multiple converters are needed to provide the microprocessor with adequate power. By ensuring that current is shared equally among multiple converters to within 1%, the Si9143CG overcomes the thermal limitations of traditional voltage-mode controllers and current-mode controllers, where too much power being derived from a single converter can result in thermal runaway.

The Si9143CG can also be configured into a redundant power system, where the isolation of any shorted converters would be accomplished by the use of ORing diodes.

In addition to its current sharing feature, the Si9143CG operates at up to 1 MHz, the highest switching frequency available for this device type, minimizing the size of passive components. Combined with a 10MHz error amplifier, the Si9143CG provides an ultra-fast 5us transient response, necessary in a high-performance microprocessor power supply.

For more information circle 272 on the reader service card or contact distributors Braemac or Avnet VSI Electronics.





## 18-bit stereo DAC for audio

Burr-Brown's new low cost PCM1733 is a general purpose stereo audio digital-to-analog converter (DAC) offering exceptional 18-bit, 96kHz performance. This makes the device well suited for a wide variety of high volume, mass market consumer audio applications demanding CD-quality audio at a low cost — such as PC add-on cards, PC motherboards, digital satellite set-top boxes, effects processors, Zoom-Video ports for portable PCs, and low cost DVD (digital versatile disc) and CD players.

The PCM1733 features an on-board 8X interpolation function with optional digital de-emphasis at 44.1kHz, and accepts digital audio sampling frequencies up to 96kHz, always at 8X oversampling. The DAC contains a 3rd order Delta-Sigma modulator, a digital interpolation filter, an analog output amplifier, and accepts 18-bit input data in either normal or I<sup>2</sup>S formats.



It also operates from a single +5V power supply and offers 95dB dynamic range, -84dB THD+N (Total Harmonic Distortion + Noise), and 97dB SNR (Signal-to-Noise Ratio). The 18-bit PCM 1733 is pin-for-pin compatible with Burr-Brown's existing 16-bit PCM1725.

For more information circle 274 on the reader service card or contact Kenelec, 2 Apollo Court, Blackburn 3130.

## Low noise 20-40GHz GaAs amplifiers

Alpha Industries of the USA has released a range of GaAs MMIC 20-40GHz low noise amplifiers and medium power (to 500mW) amplifiers. Like other Alpha products the new devices go through stringent screening and quality control conformance specifications as detailed in MIL-PRF-38358 for integrated circuits. Such testing is suitable for launch vehicles and satellite applications.

Other features of the devices include 0.25µm MESFET and PHEMT processes, on-wafer DC and RF testing, a 0.004" thick die, Ti-Pd-Av gate metallisation and nitrite passivation of the gate area.

For more information circle 275 on the reader service card or contact Electronic Development Sales, Unit 2A, 11-13 Orion Road, Lane Cove 2066.

## 'Fastest 4Mb synchronous ZBT SRAM'

Integrated Device Technology (IDT), the pioneer of Zero Bus Turnaround (ZBT) architecture, has introduced what it claims is the industry's fastest four megabit flow-through synchronous ZBT SRAM. The 4Mb product, also available in a pipelined version, provides higher levels of performance and density for communications switching and networking products.

The new IDT71V546 (pipelined version) and IDT71V547 (flow-through version) are 3.3-volt ZBT SRAMs with 128K x 36 configurations. The 71V547 is the fastest flow-through device available, operating at 100MHz with an 8ns clock-to-date access time. The 71V546 pipelined device operates at 133MHz with a 4.2ns clock-to-date access time.

ZBT SRAMs are suitable for performance-driven networking products, such as switches and routers, that require memories with both high bandwidth and the capability of intermixing read and write operations in any combination. In addition, all critical timing parameters for ZBT SRAMs are referenced to the rising edge of the synchronous clock, which simplifies the design of high-bandwidth switching systems.

For more information circle 276 on the reader service card or contact GEC Electronics Division, Unit 1, 38 South Street, Rydalmere 2116.

## AMD adds 50MHz Am186 embedded controller

AMD has introduced the highest performance member of its Am186 microcontroller family, the 50MHz Am186ER microprocessor. This has a 25% faster clock speed than previous models, and the addition of 32KB on-chip SRAM gives the device a rated performance of 6.6 MIPS — 386-class performance at a 16-bit price.

The new microprocessor is said to be ideally suited for the ever-increasing CPU requirements of a broad range of embedded communications, mass storage and general embedded applications. In addition to the faster processor speed, the 32KB of zero wait-state SRAM on the chip helps developers reduce system costs, lower system power requirements and save board space in the design cycle.

The Am186ER features an asynchronous serial port, a synchronous serial interface, DMA, timers, an interrupt controller, general purpose programmable I/Os and chip selects, including a glueless interface to external RAM/ROM. As a 3.3V optimised part, power consumption is substantially reduced while the ability to interface with 5V devices is retained through 5V tolerant I/Os.

For more information circle 277 on the reader service card or contact AMD Australia, Level 14, 33 Berry Street, North Sydney 2060.



## New DPAK TrenchFETs offer Ron below 10mΩ

Two new power MOSFETs that set a record for on-resistance in the DPAK have been released by Siliconix. The new devices, built on Siliconix' 32 million-cell Trench technology, offer an on-resistance of just 7mΩ for the N-channel SUD50N03-07 and 10mΩ for the P-channel SUD45P03-10. Both of these maximum ratings are said to be the lowest in the industry for a power MOSFET in this package.

The new TrenchFETs can handle approximately a third more current than previous-generation MOSFETs, while allowing designers to maintain the same thermal design. They also provide designers with a more 'muscular' alternative to SO-8 devices like the Si4410DY and Si4420DY, which can handle a maximum of 10 to 12.5A. With only a modest increase in footprint, maximum usable current for the new DPAK devices is 20A for the N-channel SUD50N03-07 and 15A for the P-channel SUD45P03-10. For more information circle 279 on the reader service card or contact distributors Braemac or Avnet VSI Electronics. ♦

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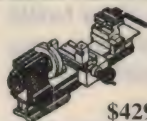
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# Designer's Guide

## to Charging Li-Ion Batteries - 1

Offering impressive advantages in terms of size, weight and energy storage density, lithium-ion batteries are fast becoming the power source of choice for today's compact portable electronic equipment — such as portable computers and cellular phones. However they require careful treatment to ensure reliable and safe recharging. Here's an explanation of how they work, and their basic charging needs, from an expert at Analog Devices Inc.

by **Joe Buxton** Battery Chargers Design Engineer, Analog Devices Inc.

**L**i-Ion rechargeable batteries are finding their way into many applications due to their size, weight and energy storage advantages. These batteries are already considered the preferred type in portable computer applications, displacing NiMH and NiCad batteries, and cellular phones are quickly becoming the second major marketplace for Li-Ion.

The reason is clear: Li-Ion batteries offer many advantages to the end consumer. In portable computers, Li-Ion battery packs offer longer run times over NiCad and NiMH packs for the same form factor and size, while reducing weight. The same advantages are true for cellular phones. A phone can be made smaller and lighter using Li-Ion batteries without sacrificing run time. As Li-Ion battery costs come down, even more applications will switch to this lighter and smaller technology.

Market trends show a continual growth in all rechargeable battery types, as consumers continue to demand the convenience of portability. Market data for 1997 shows that approximately 200 million cells of Li-Ion will be shipped, compared to 600 million cells of NiMH. However, it is important to note that three cells of NiMH are equivalent to one Li-Ion cell when packaged into a battery pack. Thus, the actual volume is very close to the same for both.

1997 also marked the first year Li-Ion was the battery type used in the majority of portable computers, displacing NiMH for the top spot. Data for the cellular market showed a shift to Li-Ion in the majority of phones sold in 1997 in Europe and Japan.

Li-Ion batteries are an exciting battery technology that must be watched. To make sense of these new batteries, this design guide explains their fundamentals, their charging requirements and the circuits to meet these requirements.

### Li-Ion battery chemistry

Fully understanding a Li-Ion battery requires a little chemistry. Metallic lithium was first used in a few specialized rechargeable batteries, but it is extremely reactive. It actually burns and generates high levels of heat when placed in water. Because of this, it was never practical for a consumer-based battery. However, it was recognized as having excellent electrochemical properties for rechargeable batteries.

The development of Lithium-Ion (Li-Ion) based batteries retained the beneficial electrochemical properties of metallic lithium without exhibiting most of the safety drawbacks. However, care must still be taken to not overcharge a Li-Ion battery. Overcharging results in the formation of pure lithium metal, which can react and cause overheating, fire and even explosions in extreme cases. Most

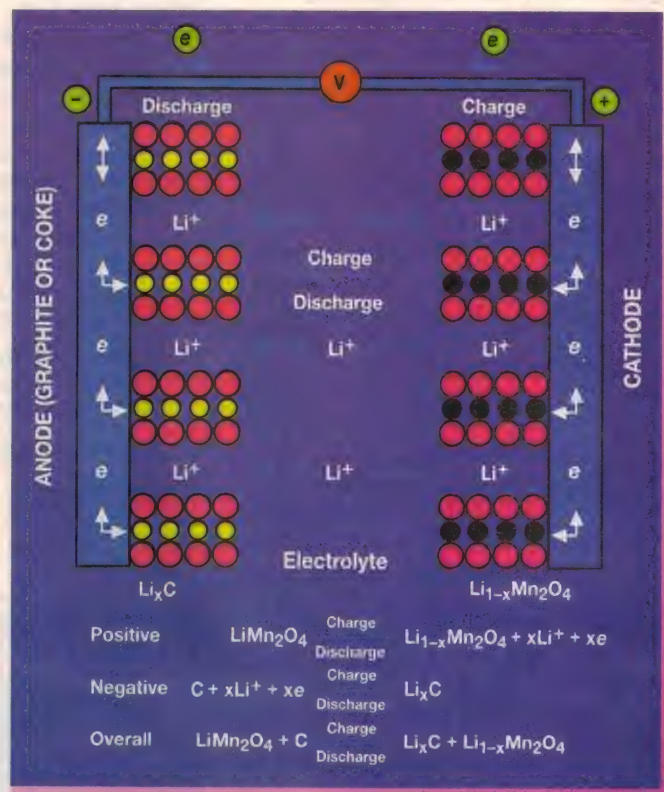


Fig.1: The electrochemical operation of a Li-Ion cell.

Li-Ion batteries have built-in safety mechanisms such as pressure actuated electrical disconnect to prevent the most drastic consequences, but careful circuit design must still be done to ensure that the battery is not overcharged. At the very least, the battery will be damaged and have a shorter lifetime.

Fig.1 shows a chemical model of a Li-Ion cell (From Linden, D., *Handbook of Batteries*, 2nd Edition, McGraw-Hill 1995). It consists of an aluminum cathode coated with a lithium-based compound. The anode is made of copper, coated with either carbon or graphite. The choice of the specific material does affect the electrical properties of the battery. For example, one of three lithium-based compounds is typically used. By far the most common is  $\text{LiCoO}_2$ , which is a safe,



high-capacity compound. LiNiO<sub>2</sub> is less expensive and has high capacity, but it tends to be less safe. Finally, LiMn<sub>2</sub>O<sub>4</sub> is the lowest cost alternative but at the expense of reduced capacity. All three compounds are found in various Li-Ion batteries, so do not be confused when different materials are quoted by the manufacturers.

The choice of the anode material affects two major properties of the battery: the end-of-charge voltage and the internal resistance. A graphite anode has lower resistance and a higher end-of-charge voltage of 4.2V. Carbon, on the other hand, has higher resistance and an end-of-charge voltage of 4.1V. Check the battery specifications for the particular end-of-charge voltage. In either case, the battery must not be overcharged by more than 1% above the rating.

The discharge profile of the two types of batteries is shown in Fig.2. Notice that the graphite battery has a flatter discharge slope than the coke battery. This is due to the lower internal impedance of the battery. Typically, a Li-Ion battery is usable from its maximum charge voltage of 4.1V or 4.2V down to a minimum discharge voltage of approximately 2.5V. Again, check with the battery manufacturer for the recommended operating range.

### Comparison with NiMH and NiCad

Which rechargeable battery to use is often a choice between NiCad, NiMH and Li-Ion. Fig.3 shows a table that compares the three battery types based on their capacity, lifetime and cost. Notice that Li-Ion batteries have a higher energy density per volume and weight. This means that a portable computer or cellular phone with a Li-Ion battery can be made smaller and lighter than the same design with a NiCad or NiMH. An alternative is to make the equipment with the same weight and size, but with a significantly longer operating time per charge. For these reasons Li-Ion is quickly becoming the most popular choice for cellular phones and portable computers, even if the cost is higher.

Li-Ion also has a low self-discharge rate, which means that the battery will retain its charge while sitting idle. The self discharge for NiCad or NiMH is two and a half times to over three times greater than Li-Ion. Furthermore, Li-Ion does not exhibit the memory effect found in some NiCad batteries. Lastly, NiCad has environmental concerns regarding its disposal, because of the cadmium.

There are some applications where the properties of NiCad are still needed. The most popular of these is power tools. In this case, the low impedance of NiCad batteries is needed for the high power surges. A Li-Ion battery's internal impedance means that high currents cannot be delivered efficiently.

### Li-Ion charging

Fig.4(a) shows the charging voltage and current profiles for a Li-Ion battery. When a discharged battery is placed into the charger, the battery voltage is low and the charger is in a constant current mode. In other words, the charger circuit controls the charge current to a pre-set level. As the battery voltage increases during charging, it eventually reaches its end-of-charge voltage (4.2V in this case). At this point, the current begins to taper off. Now the charger is in constant voltage mode, controlling the battery voltage to 4.2V. The current continues to taper off, until it essentially reaches zero. Typically, Li-Ion charging is terminated after the current falls below a reasonably low level, such as 80mA. An additional 30 to 60 minutes of low current charging may be used optionally to top off the battery.

It is worthwhile to compare this charge curve with that of NiCad and

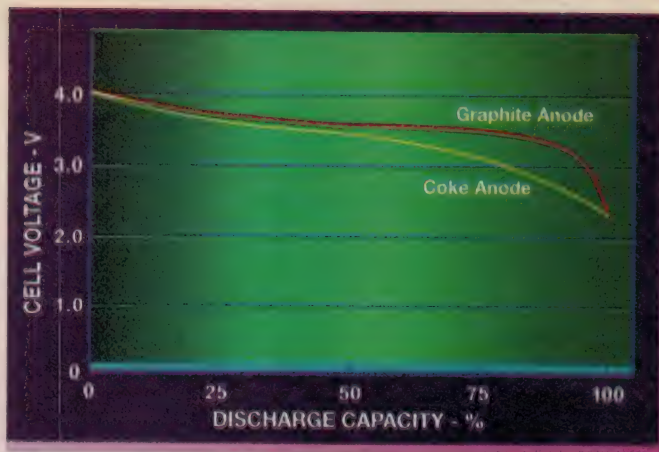


Fig.2: Discharge profiles of Li-Ion cells with graphite and coke anodes.

NiMH batteries. Their characteristics for fast charge are shown in Fig.4(b). For these two batteries, the charge current is set to a programmed level and the battery voltage and temperature are monitored.

In the case of NiCad, the most common charge termination scheme is called " $-\Delta V/\Delta t$ ". The charger circuitry monitors the battery voltage and looks for the point at which it begins to decrease. At this point the charger switches to a trickle mode and reduces the current by 90%. For NiMH, the temperature is monitored and the charge terminated based on " $\Delta T/\Delta t$ ". NiMH also has a decrease in battery voltage, but

the magnitude is much smaller than NiCad, so it is difficult to detect. However, the temperature increase is large enough to detect and terminate the charge. Like NiCad, a NiMH battery is placed into trickle charge mode at approximately 10% of the full charge current.

Both of the charge termination schemes for NiCad and NiMH actually require a fair amount of circuitry. In both cases microcontroller functionality needs to be combined with an analog-to-digital converter and a tempera-

	Li-Ion	NiCad	NiMH
Energy Density (W-Hr/kg)	90	40	60
Energy Density (W-Hr/l)	210	100	140
Operating Voltage	3.6	1.2	1.2
Lifetime (approx. cycles)	1000	1000	800
Self Discharge	6%/mo.	15%/mo.	20%/mo.

Fig.3: Li-Ion performance compared with NiCad and NiMH cells.

ture sensor to monitor the temperature and voltage. The microcontroller needs to compare readings to detect when either the voltage decreases or the temperature starts to rise quickly. Finally, the microcontroller needs to control the charge current to set it in full charge or trickle charge mode.

In contrast, charging a Li-Ion battery is actually a fairly straightforward process of voltage limiting, assuming that the precision requirements are met. When charging a Li-Ion battery, the most critical parameter is the end-of-charge voltage. Most battery manufacturers require a  $\pm 1\%$  tolerance around the end-of-charge voltage of either 4.1V or 4.2V per cell. However, other parameters are important as well. For example, the minimum charge voltage is typically 2.5V. Before a battery is charged, its voltage should be checked to determine if it is in the acceptable charge range,  $2.5V < V_{BAT} < 4.2V$ , for example. Again, check with the battery manufacturer for recommended charging ranges.

Battery capacity, expressed as C, is given in Amp-hours or mA-hours. It is used to estimate the total operating time of the battery given a certain operating current. For example, a typical Li-Ion battery is rated as 1600mAh. If the battery is operated at 400mA, it should operate for four hours. Unfortunately, it is never possible to realize the entire capacity of the battery due to internal losses. The



## Charging Li-Ion Batteries

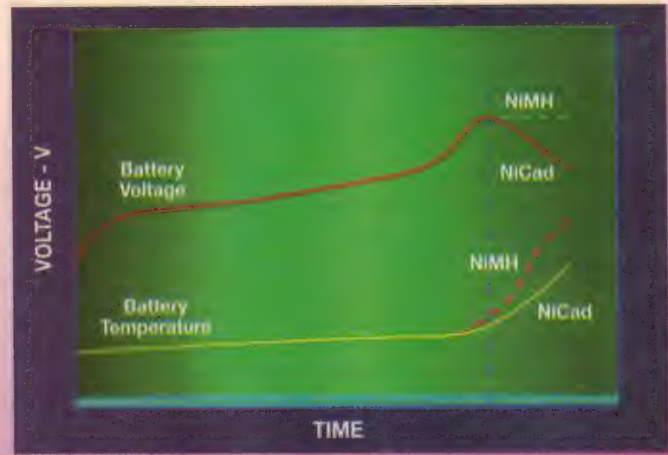
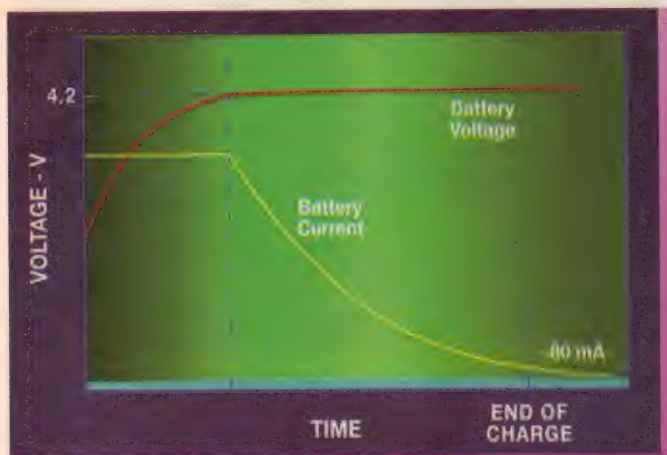


Fig.4: The charging characteristic of a Li-Ion cell is shown in (a), at left, while the equivalent curves for NiCad and NiMH cells are shown in (b) at right.

graph in Fig.5 shows the effect of the operating current on the battery capacity. Higher currents result in dramatically reduced operating capacity, primarily due to the internal impedance. This graph further illustrates why Li-Ion batteries are not appropriate for high current applications such as power tools.

During charging the recommended charge current is often expressed as C-rate. The C-rate measures how much current would be needed to fully charge the battery within one hour, assuming no losses. Of course, losses are present that do slow down the total charge time. For a 1600mAh battery, the C-rate is 1600mA.

Manufacturers often specify the recommended charge current as a function of C-rate. In other words, a 1C charge current equals 1600mA. A 0.1C charge current equals 160mA. Check the C-rate specification for the recommended charge current of the battery you are using.

### What about a 'battery pack'?

So far we have concentrated on a single cell Li-Ion battery. However, many batteries have multiple cells, which are combined into a battery pack. The pack usually includes some form of in-pack electronics, whose main function is to protect the pack from overcharging.

For example, if a poorly rated external charger is used with a Li-Ion battery, the pack protection circuitry will monitor the charge voltage. If the voltage exceeds 4.2V per cell, the pack protection will dis-

connect the battery, usually with two internal MOSFETs.

For more robust operation, the in-pack circuitry should monitor each cell. For example, if three cells are stacked serially, the overall pack charge voltage is 12.6V. Inside the pack, however, each cell still has a 4.2V limit. Thus, the in-pack electronics should disconnect the battery in the case of overcharge of any one of the three cells.

The in-pack electronics usually contain an over-discharge monitoring circuit to disconnect the battery when the cell voltages drop below 2.5V. Additional circuitry could include short circuit protection and temperature detection to prevent battery charging at temperatures above 60°C or below 0°C. More sophisticated circuitry may also include cell balancing and gas gauge functionality.

Even with built-in pack protection, the charger needs to be accurate. Since the consequences of overcharging a Li-Ion battery are drastic, the redundancy of an accurate charger and accurate in-pack protection is desirable.

### Battery charging solutions

The main criterion in designing a Li-Ion battery charger is the accuracy. Three different solutions from Analog Devices make the job of designing an accurate charger easy. These are the ADP3801/02, the ADP3810/11 and the ADP3820 Li-Ion battery chargers. While the specific details and features of each product family are different, they all offer high accuracy in a system-level specification that takes the guesswork out of designing an accurate charger from discrete components.

The ADP3801/02 uses a switching regulator topology for high efficiency and offers  $\pm 0.75\%$  battery voltage accuracy. The parts also include valuable features such as an end-of-charge detector, a low dropout regulator, programmable final battery voltage and dual battery inputs.

The ADP3810 integrates the analog control and sensing circuitry with a direct opto-coupler output, which makes it ideal for off-line applications. It offers  $\pm 1\%$  final voltage accuracy in four different options: 4.2V, 8.4V, 12.6V and 16.8V.

The ADP3820 rounds out the battery chargers with a linear charger controller. It offers the lowest part count solution where a linear charger is appropriate. Like the ADP3810, it offers  $\pm 1\%$  final battery voltage accuracy.

In the second part of this guide, we'll look at how these devices are used in Li-Ion battery chargers using the various applicable charger topologies.

(To be continued.) ♦

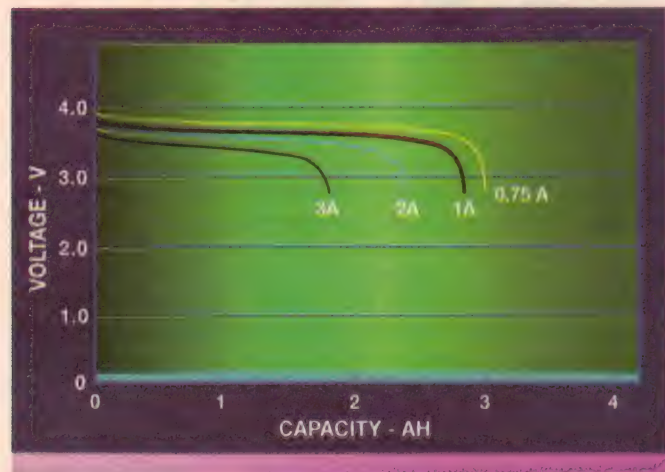


Fig.5: Li-Ion cell capacity for four levels of discharge current.

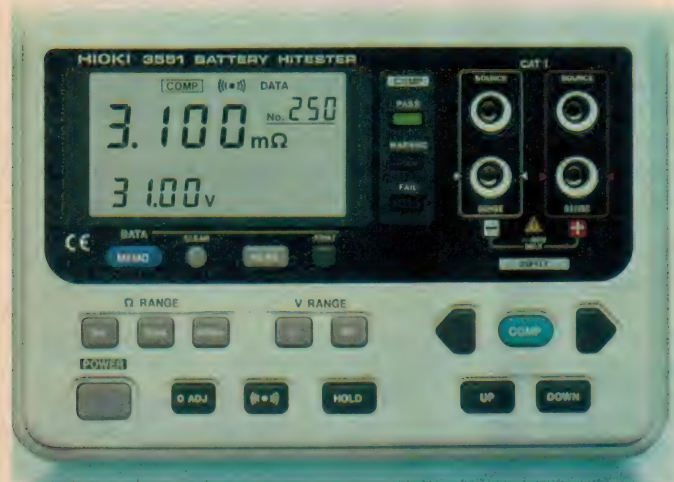


# Battery & Support Products

## Tester for UPS batteries

The reliability of an uninterruptible power supply (UPS) is only as good as its batteries, and all rechargeable batteries inevitably deteriorate during their working life. Careful monitoring of battery condition is therefore the key to ensuring cost-effective UPS operation. A recent refinement in this area is internal impedance monitoring, which allows battery failure to be predicted with a high degree of confidence, and the battery replaced before this occurs.

Japanese manufacturer Hioki developed the Hioki 3551 Tester specifically for maintenance operation on UPS lead-acid backup batteries. It measures internal impedance, voltage and temperature of the battery under test. The instrument is provided with a memory capable



of storing up to 260 separate comparator results. An optional printer provides both hard copy as well as a statistical analysis.

Also available is the Hioki 3555 Tester, designed to test portable appliance batteries including NiCad, NiMH and lithium-ion types. This instrument measures internal impedance as well as voltage, and through the aid of comparator functions can provide warnings of impending failure.

For more information circle 202 on the reader service card or contact Nilsen Technologies, 150 Oxford Street, Collingwood 3066.

## Three-step auto lead-acid charger

The Amtex 9640 is claimed to be one of the most advanced low power chargers on the market. Fully automatic, it is designed for both cyclic and standby charging of rechargeable lead-acid batteries. The advanced switch-mode design comes in a compact plug-

pack case and offers 40 watts of power.

The charger has three different operating modes, with a tricolour LED used to indicate the current mode. Boost mode (red) provides constant-current charging to bring the battery voltage up to maximum cycle value (e.g., 14.7V), with about 80-95% of full capacity; timer mode (yellow) then provides timed constant-voltage charging, for fast delivery of the remaining charge; finally float mode (green) reduces the current level to a value which allows the battery to be left connected for an unlimited time without overcharging.

The 9640 features a wide 190-264V input range, reverse polarity protection, low leakage current when the mains is disconnected, and automatic start of a new charging cycle when the battery voltage drops.





For more information circle **203** on the reader service card or contact Amtex Electronics, 2A Angas Street, Meadowbank 2114.

### Rectifiers for telecom batteries

Melcher AG has expanded its LT family of telecoms rectifiers with 24V and 36V DC output versions and a new input range to address 110V AC supply lines. Already well established in conventional analog telecoms, GSM and CATV markets for 48V DC battery-backed distributed architecture systems, the new units extend applications into other markets such as the industrial controls field.

Using a special single-switch conversion topology, the rectifiers offer an unparalleled 91-93% conversion efficiency, providing 400-550W of output power over the temperature range -25 - 71°C. Up to three power modules can be hot-plugged into a single 3U x 19" rack frame to provide up to 1650W of output power in N+1 redundant operation with full signalling. The output can be remotely temperature compensated to ensure that the correct charge is always applied to a bus battery.

With SELV output, safety agency approval to EN60950 and UL1950, a power factor greater than 0.99 and harmonics well below IEC61000-3-2, the units employ standard DIN 41612H15 connectors and are easy to design in.

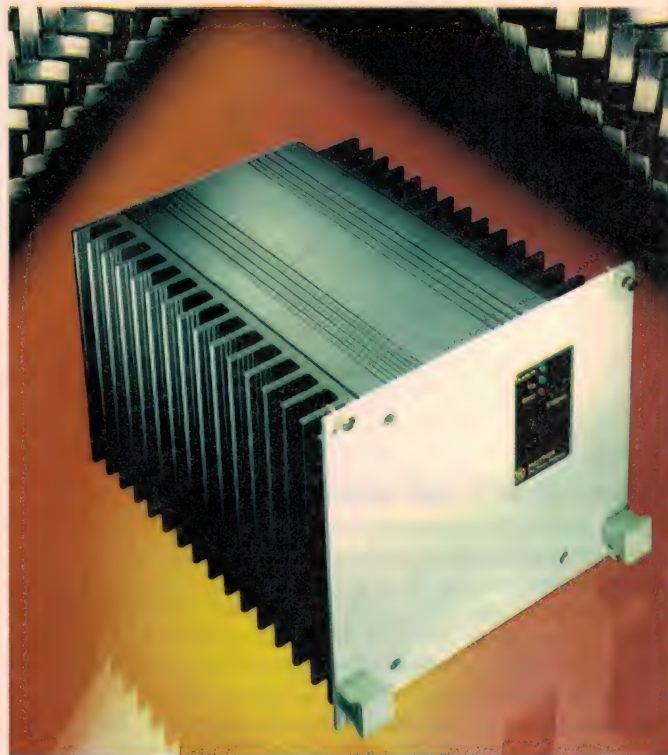
For more information circle **204** on the reader service card or contact Scientific Devices Australia, 118 Atkinson Street, Oakleigh 3166.

### Additive enhances lead-acid batteries

Battery Equaliser is a liquid additive designed to extend the life and enhance the power capacity of a lead-acid storage battery. It's claimed to achieve this by using electrochemical action to dissolve the sediment which forms inside such batteries during normal use, and by distributing an alloy throughout the working parts of the battery.

In an untreated battery, sediment begins building up on the plates as soon as electrolyte is added to the new battery. This adds to each cell's internal resistance and gradually reduces the cell's ability to accept and hold a charge; it also tends to provide a path for internal discharging. By dissolving the sediment and placing it back into solution, Battery Equaliser improves battery performance significantly.

The alloy deposited by the formulation impregnates the brittle lead and restores toughness to the internal plate structure, thereby increas-



ing the battery's ability to withstand physical shock.

It's claimed that batteries treated with Battery Equaliser can have their effective life span increased by up to four times.

Now being manufactured in Australia under licence, Battery Equaliser comes in a 100ml bottle which is sufficient for a single dose on the six cells of a standard car or boat battery. A one-litre pack is also available for traction batteries or other larger installations. The 100ml pack is available from BBC Hardware, Hardware Warehouse and other national retailers.

For more information circle **201** on the reader service card or contact Battery Equaliser Australia, PO Box 267, Eastwood 2122. ♦

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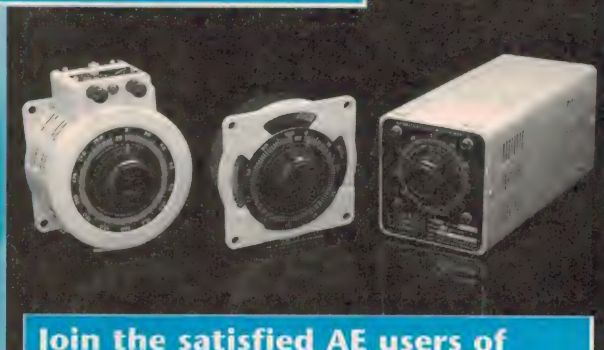
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## Notes & Errata

### Super Ear (May 1998):

An incorrect PC board number is quoted in the parts list — the correct number is 98se05, as shown on the published artwork.

Also, the value of C4 is shown as 820pF in the schematic, while it is listed as 180pF in the parts list and PC board overlay diagram. The actual value of this capacitor depends on the break frequency you select (as outlined in the text) so use the table in Fig.2 to select the final value for both this capacitor and C3.

### IR remote volume controller (July 1996),

### Pro Series 4 preamp (December 1996):

Depending up the brand of 74HC132 chip used in the IR transmitter unit, it may not be possible to adjust the oscillator to the required 38kHz using RV1 (1k). If this seems to be the case, try replacing RV1 with a 10k trimpot or perhaps changing R1 to 6.8k — many thanks to Norm Vella for pointing out this problem.

## EA's Web Site

The Electronics Australia World Wide Web site is now operational, in a preliminary form. On it you can access and download all of the files available on our very popular Reader Services BBS — including project index files, software for our projects, notes & errata, useful shareware and so on. You can also see what's in the latest issue, and even take out or renew a subscription to the magazine if you wish. We'll be adding extra features and services as we go along, so please pay us a visit at:

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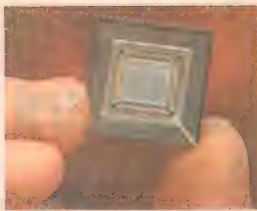
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# Silicon Valley Newsletter.....

## Silicon Valley team builds first quantum computer

A TEAM OF RESEARCHERS from Stanford University, UC Berkeley and IBM's Almaden Research Laboratory in San Jose announced that they have built a prototype of the world's first quantum-physics-based computing machine. Using a modified nuclear Magnetic Resonance Imaging (MRI) system, commonly used in hospitals around the world, the researchers were able to manipulate the carbon and hydrogen elements in chloroform molecules in such a way that they were able to store information and perform calculations. If perfected, the technique could lead to computers that would operate thousands, if not millions of times faster than any computer today.

Practical application of the technique appears at least a decade away. But Stanley Williams, a Hewlett-Packard physicist who directs HP's own quantum computing research, said the development of a working model was significant. "This will reshape the face of science."

If the current world of binary digital computing, which uses zeros and ones, is difficult to comprehend for the vast majority of people, quantum technology will increase the level of confusion exponentially. For example, while in the traditional world a particle or element is either zero or one and can be present in only one place, in quantum physics elementary particles can be both zero and one, or neither, and can be present in every possible place — at the same time.

The implication for computers is that a quantum physics-based computer could be asked a question and provide all possible answers, all at the same time. The trick might be to figure out the right answer from among all of the answers, of course, but that is where the IBM research team made its biggest breakthrough.

"It is very exciting. I think we were poised to do this kind of research in Silicon Valley, because we have an excellent combination of multi-disciplinary people here, physicists

and computer engineers", said Isaac Chuang of the IBM Almaden laboratory, who started the project while still at Stanford University.

The breakthrough in the development project came when the group was able to have the system pick the right answer to a question that had four possible answers. Standard computers would simply query each answer for its accuracy until it would stumble upon the right answer. On average it would take a computer 2.75 queries to get to the right answer in such a simple equation.

The IBM quantum system was able to instantly produce all four answers and pick the right one in a single query. "With this system, you can be in four places at the same time", Chuang explained.

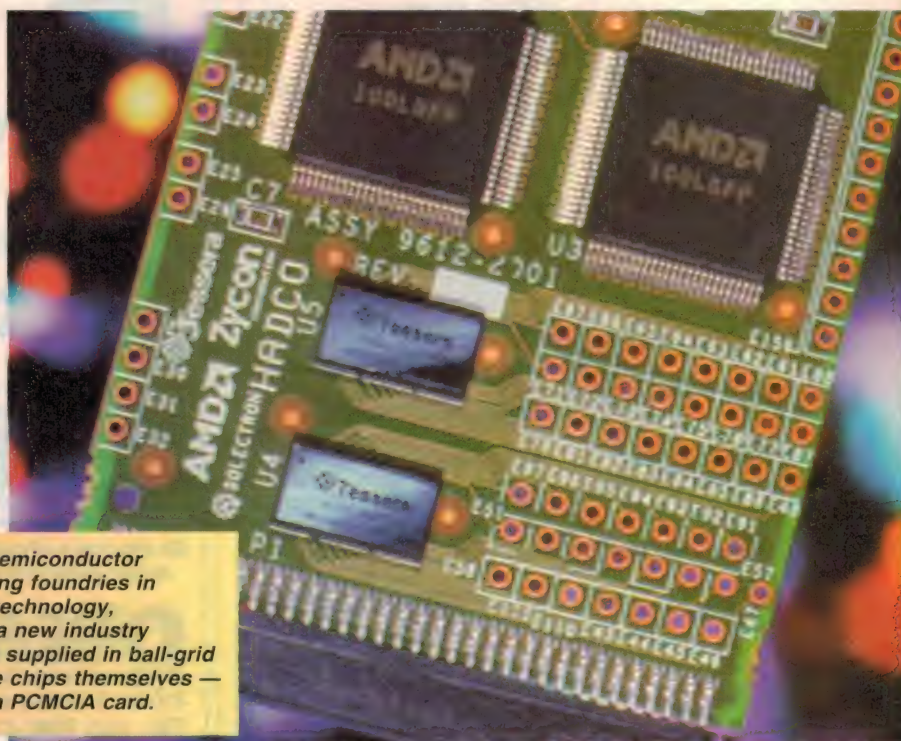
The latter achievement was supposed to be impossible. The problem Chuang's team had to overcome was to maintain the chloroform molecule in a stable, controllable state long enough for the calculation to be completed. To do this, the Silicon Valley team, in cooperation with scientists from MIT and Oxford University, developed a modified MRI system that controls the orientation of a chloroform molecule's nucleus just prior to treating

the molecule with radio waves. By controlling the orientation of the nucleus, the researchers were able to use different orientations to represent traditional binary one and zeros. For example, an upward orientation would represent a one and downward orientation a zero. If the orientation is horizontal, the state would be halfway between one and zero, something that is not possible in traditional computing but is fundamental to the principle of quantum computing.

The MRI technique also enabled the researchers to overcome the problem of reading data from the molecule. Such efforts have previously failed because in quantum physics, the outcome of a quantum event is altered simply by observing it. But because the MRI technology allows large numbers of molecules to be observed all at once, the altering effects of quantum event measurement is canceled.

One of the beauties of the IBM research and the use of MRI is that the experiments can be conducted in a room temperature environment, unlike other efforts which required temperatures of near absolute zero to control individual molecules.

Quantum computers could play an important role in the future, particularly in the area



**AMD has recently joined 10 other leading semiconductor manufacturers and seven major IC packaging foundries in licensing Tessera's Micro BGA packaging technology, confirming its international acceptance as a new industry standard. The technology allows dice to be supplied in ball-grid array packages only slightly larger than the chips themselves — like these flash memory devices (blue) on a PCMCIA card.**



of running searches on vast databases, or in cryptography where they can be used to crack coded data that uses large prime number keys. Similarly, they can be used as powerful search engines on the Internet, able to find a single word or string of words from among all of the data available on the World Wide Web.

Chuang and Williams said their companies hope to have quantum-based computers commercially available after the year 2010.

## Hitachi bets on 256Mb flash memories

JAPAN'S HITACHI has announced plans to quickly boost production and availability of 256-megabit flash memory chips in 1999. The company hopes to produce around 500,000 such chips a month at a fab in Ibaraki Prefecture, north of Tokyo. Samples of the chips are expected to be available in the latter half of 1998.

The 256Mb ICs use a revolutionary new technology that doubles the data storage capacity of each transistor from one to two bits each.

## TI sees only 5% chip growth in 1998

FOLLOWING ON FROM a Dataquest forecast of only 8% growth for the worldwide chip market in 1998, Texas Instruments said it sees only a 5% expansion of the market this year.

"We have adjusted our worldwide forecast to 5% or less this year", said Rich Templeton, executive VP of Texas Instruments, adding that the lower growth rate is due to near-term caution in the Americas and weakness in Japan.

Templeton added that Texas Instruments continues to see strength in the communications, wireless and networking markets, with over 30% growth in the so-called digital signal processor market.

## Borland becomes Inprise

BORLAND INTERNATIONAL, which has been on a roller-coaster rags-to-riches-to-rags ride for much of its existence, is changing its name to Inprise Corporation on June 5. Along with the new name the company is also changing its market focus to the area of so-called 'middleware' — software products that act as translators between different types of hardware and business software.

"The name Inprise is a way to identify ourselves with new markets, a new customer base and a new strategy", said Del Yocam, Borland's CEO and chairman. "This is a new company."

Borland, once the third largest software company in the world, is best known for its computer programming languages and tools, which help professional programmers write other software. However the company stum-

bled in the early 1990s by making several bad acquisitions, most notably the Ashton-Tate database publisher. It also lost a key lawsuit against Lotus Development, which had accused the firm of having copied the look and feel of Lotus 1-2-3 in its Quatro Pro spreadsheet software.

But the company's biggest problem was that its success in the software tools market had made it a direct enemy of Microsoft. Software tools were once Microsoft's biggest cash cow, but Borland came to dominate the market in the early 1980s. In a famous episode, Microsoft chief Bill Gates once issued a memo to Microsoft officials to do whatever it takes 'to kill Philippe', in reference to then Borland chief Philippe Kahn.

Rather than physically harm Kahn, Microsoft slashed the prices of its development tools, forcing Borland to follow suit and see its sales and profits plummet.

## Hyundai sells last US chip business

IN A FURTHER re-structuring of its semiconductor operations, Korea's Hyundai Electronics announced it has agreed to sell its remaining US-based semiconductor business — Odeum Microsystems — to Oak Technologies for an undisclosed amount. Odeum specializes in digital video imaging.

Hyundai said the proceeds from the sale will help the company invest in new plants and equipment for its Korean-based DRAM operations. In February, Hyundai sold another US-based company, Symbios Logic to Adaptec for US\$775 million.

## FTC approves Intel buying DEC's Alpha

THE US FEDERAL TRADE Commission has granted Intel's request to complete its proposed US\$1+ billion settlement agreement with Digital Equipment, which included a cash payment of US\$700 million to take over Digital's Alpha microprocessor operations.

The deal for Digital's chip manufacturing business was part of an settlement that put an end to a nasty patent infringement lawsuit Digital filed a year ago in which Intel was accused of having illegally infringed on 10 of Digital's patents in the design and manufacture of the Pentium processors. The approval of the Intel-Digital deal required a majority of the five-member FTC.

Under the terms of the deal, Intel has promised to continue to manufacture Digital's Alpha processor at Digital's Hudson plant and Digital will retain the rights to the chip and its design teams, which will continue to develop future Alpha generations. Intel also has an agreement to the rights to manufacture and sell the StrongARM processor, which Digital developed under a license from Advanced RISC Machines. ♦

## Major AMD shareholder wants Sanders out

ADVANCED MICRO DEVICES chairman and CEO Jerry Sanders III has again come under heavy public attack from one of the company's largest shareholders, CalPers — America's largest public pension fund with more than US\$140 billion in assets, including 500,000 shares of AMD stock.

CalPers officials issued an appeal to fellow AMD shareholders to support a proposal to force Sanders to give up his dual position of chairman and CEO. CalPers believes AMD shareholders have been suffering unnecessarily because as CEO, Sanders cannot provide the appropriate perspective which an outside board chairman typically brings to a company's management.

"When the board's chairperson is also an officer, employee or otherwise closely related to the company's management, it is difficult for that person to objectively perform a monitoring and evaluation function. We believe that an independent chairperson would best ensure that the interests of shareholders are served, rather than the interests of management," said CalPers CEO James Burton. Burton noted that US\$100 invested in AMD's selected peer group, the Technology 500, on December 31, 1992 would have been worth \$369 on Dec. 31, 1997. By contrast, \$100 invested in AMD would have been worth only \$98 over the same period.

At AMD, spokesman Scott Allen said forcing a separation of Sanders' powers would be a mistake. In fact, AMD only benefits from a single individual in the two key positions, providing the company with uniform vision and strategy.

## Gateway drops the 2000

GATEWAY 2000, the company whose explosive growth as a direct marketer has made it one of the top five PC vendors worldwide, is dropping the 2000 from its name.

"As the millenium approaches, it's natural for us to drop the '2000' so we don't sound dated. And most people know us by Gateway anyway", said spokeswoman Angela Peacock.

Gateway also announced that its first-quarter earnings rose to US\$75.87 million from \$67.52 million in the same period last year. Revenues climbed to US\$1.7 billion from \$1.4 billion.



# Adaptec's Easy CD Creator Deluxe

by Jim Rowe

**Most of the latest CD-R and -R/W drives come with bundled software which allows you to perform basic recording and copying of both data and audio CDs. Adaptec's Easy CD Creator Deluxe package gives you the tools to go rather further — especially in making your own audio, video and image CDs, and also their 'jewel case' liners.**

The cost of both blank CD-R discs and CD writer drives has now fallen to a level where, for many people, it's quite an attractive option to archive your data on CDs. (At about \$4 for 600MB, they're very cost effective.) Once you've added a CD writer to your system, though, other options also become available — like the ability to make your own audio CDs, or to make CD transcriptions of treasured old tapes, 78s and vinyl LPs.

Not surprisingly, though, the software that comes bundled with most of the newer CD-R and CD-R/W drives generally doesn't give you all of the tools you need to take full advantage of the drive's potential — or more accurately, the full potential of the computer/drive/sound-card system. That's where packages like Adaptec's Easy CD Creator Deluxe come in.

When I recently bought an HP 7200e CD Writer kit, for example, it actually came with the 'plain vanilla' version of Easy CD Creator bundled, along with Adaptec's DirectCD (for 'drag and drop' data file recording) and some HP utilities. But although this let me do quite a lot of useful things, I soon found that the setup was fairly limited in terms of things like audio recording capability and flexibility. That's why I was particularly interested, when the opportunity arose to review a copy of the full Deluxe version of Easy CD Creator...

Although it's a relatively inexpensive package, the Deluxe version gives you quite a few 'extras' over and above the basic version. Apart from anything else, there's a full A5-sized user manual (the basic version has



**A screen dump taken from CD Spin Doctor during recording — in this case, to a hard disk file.**

only online help). Then there's a program called CD Spin Doctor, which is designed to simplify audio recording from external sources such as a turntable or cassette deck. It lets you record to either a CD directly, or to hard disk (as a WAV file) as an interim step.

CD Spin Doctor is quite a nifty program, incorporating some of the noise removal facilities of Tracer Technologies' DART package, which I reviewed a couple of years ago. It can remove surface noise, clicks and plops, etc., and is therefore good for 'cleaning up' the sound from mediocre tapes or scratchy old records.

Also in the Deluxe package you get Sound Editor, a quite respectable editing program for WAV files; Picture CD Creator and Video CD Creator, respectively capable of letting you make CDs of your image files or MPEG video clips; CD Extra, which lets you make mixed audio and data discs; a fully featured version of CD Copier, which can make single session or multi-session discs (including audio copies); a utility called Session Selector, to view the various sessions on a multi-session CD; and finally a cable with a pair of RCA plugs on one end and a 3.5mm stereo plug on the other, to connect your audio recording





source to the sound card's line input.

All of the software in the package comes on a CD itself, and is compatible with both Windows 95 and NT4. On the CD there's also a Multimedia Tour, with video clips and audio to give you a quick overview of the package capabilities and ease of use.

### Trying it out

To try the Deluxe package out, I tried installing it on my new HP Vectra VL6 Pentium II/266MHz machine, with 64MB of RAM and running Windows NT4 — the same machine that the CD Writer and its

software, of course, including the 'plain vanilla' version of Easy CD Creator!

Emails to the tech support people at Adaptec didn't provide any answers (or even a reply), nor did there appear to be much specific help on their web site. However a call to the tech support guy at local distributor Anabelle Bits was much more productive. He advised that this was a known problem with version 3.01a of the software (the version on the review CD), and had been fixed in the latest version 3.01b. Following his advice, I downloaded a V3.01b patch file from the Adaptec site, installed it and all problems magically disappeared.

With this problem solved, I set out to get a feel for some of the basic functions. Using CD Spin Doctor I tried recording a few tracks from cassette tape and elderly LPs — not directly to CD, but to hard disk files first to allow me to have greater control. (Luckily this computer still has a fair bit of space free on the hard disk — at 10.5MB/minute for normal 44.1kHz stereo recording, you sure need plenty of disk space.)

There were a few initial hassles with things like making sure the Win NT4 audio mixer application had the sound card's line input turned on, and hooking up a suitable RIAA preamp for the magnetic pickup in the turntable, to feed the sound card with an amplified and properly equalised signal. But once these things were sorted out, I was soon recording quite respectable WAV files and able to make audio CDs that played without hassles on a standard audio CD player.

CD Spin Doctor turned out to be a very friendly and flexible program, although once or twice it did seem to flip into a weird mode where the on-screen 'LED VU meter' indicated the supposed presence of a high-level audio input signal when there wasn't one. It did this once in the middle of recording a WAV file, and the rest of the file turned out to have become extremely loud digital noise when I played it back.

My only other complaint about CDSD, and it's a minor one, is that when you're recording it displays a rather corny on-screen procession of cartoon musical instruments and notes. This gets a bit irritating after a while; it would be nice if you could turn it off. Overall, though, it's a practical and easy to use recording tool. The ability to clean up daggy old tracks is also nice, although with really noisy old tracks you'd probably want to use one of the specialised and more powerful packages that are now available.

You can also record audio CDs using Easy CD Creator, and in some ways this is easier to use when you're making a CD from a collection of previously recorded WAV files. ECDC is kind of integrated with NT Explorer, and lets you assemble a recording track list or 'layout' by drag-and-drop from files on the hard disk, a Zip disk, a CD in

your CD-ROM drive or wherever. You can even save these layout files for later re-use, and if you use the Jewel Case Creator facility to design artwork for your case inserts and/or disc label, the artwork actually becomes part of the layout file. (It's all linked together, with JCC taking the track names from your layout 'play list'.)

ECDC is quite flexible, and provides 'Wizards' for recording both audio and data CDs — but you're free to cancel these and do it all step-by-step if you prefer. Either way, it's easy to use.

Much the same applies to CD Copier Deluxe, which seems to be virtually identical to the bundled version except that it offers a few extra options for copying both multisession data and audio discs.

I tried out Sound Editor, which seems quite a practical little WAV file editor. I did manage to make it crash once though, simply by trying to move the cursor along to nearer the end of the file I'd opened. It may have a small bug in this area.

I wasn't able to try out Picture CD Creator, Video CD Creator or CD Extra, but my impression is that they'd be just as easy to use as the audio applications.

Overall, then, the Easy CD Creator Deluxe package provides some very practical and easy to use applications, especially for preparing and recording audio CDs from conventional analog sources. I'm quite impressed — but especially if you have one of the HP 7200 CD Writers, make sure you get the latest version 3.01b. ♦

### Adaptec Easy CD Creator Deluxe

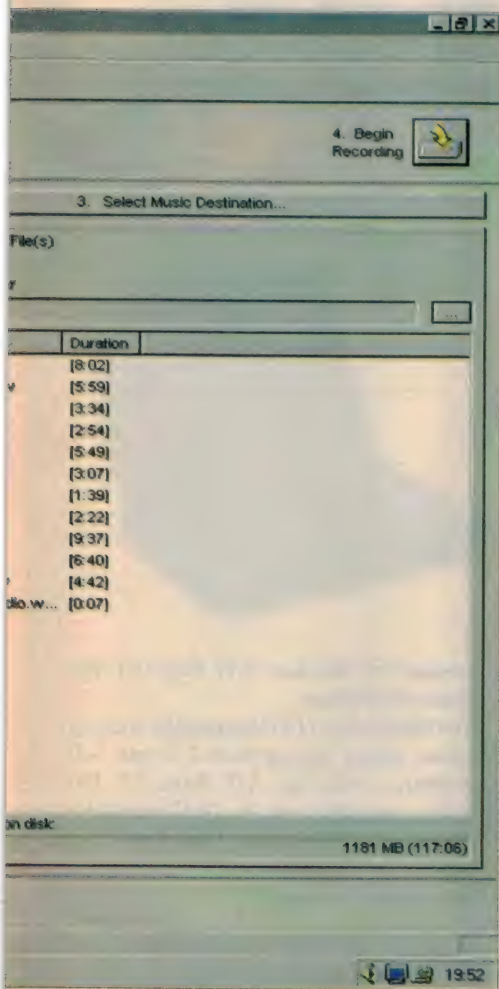
*A suite of application tools for recording audio, data, image, digital video and mixed-content CDs.*

**Good points:** Easy CD Creator's Windows Explorer tie-in and drag-and-drop facility for assembling record playlists; CD Spin Doctor's audio cleanup and auto track splitting facilities; the overall friendly, easy to use nature of all applications.

**Bad points:** Not many, especially considering the price. It would be nice if you could disable the 'cartoon instrument panorama' displayed by CD Spin Doctor when you're recording.

**RRP:** \$160 including tax.

**Available:** Through most computer dealers. Distributors are Anabelle Bits, (02) 9384 8000; Agate Technology, (02) 9878 468; Synnex Australia, (03) 9540 0555; and Tech Pacific, (02) 9381 6000.



software are installed on, needless to say. It all installed quite smoothly from the CD, using one of the usual setup 'Wizards', and I made a point of installing all of the new applications on a different subdirectory from those that had come bundled with the CD Writer (to allow later comparisons).

I did have a puzzling initial problem, when I went to use applications like CD Spin Doctor and the new version of Easy CD Creator itself. None of these new Deluxe programs seemed to be able to 'find' the CD Writer, even though NT4 knew all about it — as did the previously installed bundled



# Computer

## News & New Products

### Bubble Jet printer has scanning option

Bubble Jet printing technology inventor Canon has announced the new BJC-4300, claimed as the industry's first desktop Bubble Jet printer with (optional) full colour scanning capabilities. The colour printer also delivers photo-realistic output, high speed black text printing and continuous sheet banner printing.

Converting the BJC-4300 into a scanner is achieved simply by replacing the cartridge. The optional Colour Image Scanner Cartridge (RRP \$149) is substituted for the ink cartridge, converting the BJC-4300 to a scanner capable of up to 360dpi resolution. The user simply feeds a document, photograph or illustration through the printer for scanning into a Windows 95 compatible computer.

The BJC-4300 achieves realistic photographic output in printing mode by using Canon's PhotoRealism and Drop Modulation Technology. PhotoRealism technology produces outstanding images using low-density inks, which work together with the advanced printer driver to apply ink



on a single dot many times, producing more colour combinations and greatly increasing the colour range. Drop Modulation Technology uses a special print head design which ejects two different sized ink droplets from each nozzle, rather than only one of uniform size.

The overall result is said to be a remarkable image approaching silver halide quality, which is printed with much higher precision, improved halftones, finer and smoother colour gradations and reduced pixelation.

### 3D VGA card with frame grabber

Coreco's Bandit is a next-generation video board which seamlessly integrates an exceptional frame grabber with a high speed VGA card. A single-slot PCI board solution, Bandit transfers digitised video data directly into the on-board frame buffer and displays live video in a Window at a competitive price, making it well suited for

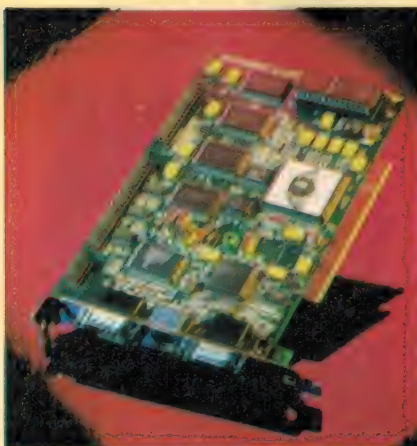


image analysis and video applications.

The board combines advanced features with the latest in 3D VGA technology. It delivers a high colour display at resolutions up to 1600 x 1024, interpolative video scaling, live mirror/inversion and non-destructive overlay of live graphics on top of video. Input from a variety of video sources is supported including NTSC, Y/C, PAL, CCIR or RS-170. In addition, an accelerated VGA controller supports DirectDraw for video operations and Direct3D for multi-dimensional graphics operations.

Bandit is claimed to be the only board on the market to offer high VGA resolutions without compromising superior quality video at a competitive price. To reduce development time and system cost, Coreco offers complete software support for Bandit including drivers for Win 95 and a developers Toolkit. Bandit software is optimized for use under Windows 95 with DirectX compatible drivers. In addition, each unit ships with a demo program that allows users to open a live video window and basic image manipulation functions.

For further information circle 160 on the reader service card or contact Kenelec, 2 Apollo Court, Blackburn 3130.

The BJC-4300 has an RRP of \$369. For more information circle 161 on the reader service card or contact Canon Australia, 1 Thomas Holt Drive, North Ryde 2113.

### HP OmniBook 7100 uses mobile Pentium II

Hewlett-Packard has announced the first product in a new family of leading-edge HP OmniBook notebook PCs. The HP OmniBook 7100 notebook PC addresses power notebook user needs, incorporating both Intel's new 266MHz Mobile Pentium II



processor and the new ATI Rage LT Pro graphics accelerator.

The OmniBook 7100 incorporates a 64-bit graphics engine having both 2-D and 3-D acceleration with the ATI Rage LT Pro graphics controller, on its 14.1"-viewable-image XGA TFT display. It also provides simultaneous pointing-device operation or a choice between a pointing stick and a track pad, and it incorporates a dual-spindle accessory module that lets a floppy-disk and a 24X CD-ROM drive occupy the same bay.

Another innovative option is a DVD-ROM accessory with up to 17GB of storage capacity, suitable for video-based training as well as sales and marketing presentations.

The new model provides the performance equivalent of a desktop PC, with a 266MHz Intel Pentium II processor and 512KB L2 cache industry-standard components. For further storage expansion, HP offers an optional ZIP or SuperDisk LS-120 drive module.

The HP OmniBook 7100 starts at \$10,800 (estimated street price including sales tax). For more information circle 162 on the reader service card or call HP Australia's Customer Service Centre on 131 347.



## Pentium based PC/104+ embedded system

Ampro Computers has announced a Pentium based embedded-PC macrocomponent, which occupies a single PC/104-Plus compliant module. The tiny (3.6" x 3.8") module, known as the CoreModule/P5i, contains the functions of an entire Pentium-based embedded-PC system and is designed for use in harsh embedded environments.

The CoreModule/P5i includes virtually everything found in a PC/AT compatible system. Included on the highly integrated module are a 133MHz voltage reduction technology (VRT) Pentium processor, up to 64MB of system DRAM, battery-backed real time clock and peripheral interfaces for serial (two 16550 buffered UARTS) ports, parallel (IEEE-1284 EPP/ECP), keyboard, speaker, floppy, IDE and USB. A built-in bootable read/write flash disk (up to 16MB) completes the suite of basic system functions, allowing fully standalone operation as a self-contained embedded computer in many applications.

Two system expansion buses, ISA and PCI, facilitate interfacing the module with application specific custom electronics or with off-the-shelf PC/104 and PC/104-Plus function modules.

For more information circle 163 on the reader service card or contact Micromax, 307 Keira Street, Wollongong 2500.



## Low cost AutoCAD alternative

Visio Corporation's new IntelliCAD 98 is claimed to be the first viable alternative to Autodesk's AutoCAD, at less than 20% of the price. IntelliCAD delivers compatibility with AutoCAD files, commands and applications and smooth integration with the Microsoft Windows desktop.

Visio engaged over 3000 beta testers to put IntelliCAD through its paces. Seasoned AutoCAD users tested it with their own .dwg drawings, AutoLISP routines, macros, menu files and custom ADS-based C++ applications. The feedback was instrumental in helping Visio fulfill its promise of AutoCAD-like functionality and compatibility at a much lower price.

Further, the testers were able to provide

valuable feedback on productivity enhancements that are not present in AutoCAD Release 14, such as IntelliCAD's Multiple Document Interface for editing multiple drawings simultaneously, Microsoft ActiveX in-place editing capabilities (as both a server and a client) and the Drawing Explorer, an intuitive tool for managing drawing layers, line types and blocks.

The IntelliCAD testing and quality assurance effort has resulted in IntelliCAD 98 being awarded the Designed for Microsoft Windows 95 and Windows NT logo certification from Microsoft Corp.

IntelliCAD is available through Visio's current distributors and resellers, including Harvey Norman, Software Resellers, Corporate Resellers and DRCAuto, for \$599.

## Turnkey DAQ for laboratories

National Instruments' new BioBench software is designed for physiological data acquisition and analysis, for use in research and academic environments. A low cost turnkey package for Windows 95/NT PCs, BioBench requires no programming to get users up and running. They can begin acquiring and analysing data immediately.

BioBench can automatically configure and acquire data from many physiological instruments from a variety of manufacturers,



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as well as acquire data directly from sensors via the company's plug-in data acquisition (DAQ) hardware, it delivers a flexible, cost-effective tool for laboratory environments in which short development time is essential.

Features include the ability to view data results and compare them with other test results. Users can store single test results to disk in test groups, thus making it easier to compare the results of several tests. Some of the analysis functions include histogram, Fast Fourier Transform (FFT), and peak detection. Users can also set alarms to trigger when data reaches certain levels; for example, an application monitoring a laboratory subject can trigger an alarm once blood pressure, temperature, or respiration reaches a predetermined point.

For more information circle **164** on the reader service card or contact National Instruments Australia, PO Box 466, Ringwood 3134.

### Wheel-enhanced TrackMan Marble+

Logitech's TrackMan Marble+ is a wheel-enhanced, thumb-operated trackball that offers high precision and reliability, as well as virtually maintenance-free operation. It features Logitech's award winning Marble sensing technology and Mouseware software.

The result of four years of extensive R&D, Marble technology uses advanced optics and neural network logic to detect movement in a manner similar to that of the human eye and transmit this information to the computer. In a Marble device, a laser-like beam illuminates a random pattern of dots printed on the ball, while an optical sensor tracks the motion.



A scrolling wheel is embedded in the centre button of TrackMan Marble+, with which the user can scroll in any Windows 95, NT or Internet application without moving the cursor over the scroll bars. Clicking the wheel activates an AutoScroll feature, allowing scrolling in all directions, including diagonally.

System requirements for TrackMan Marble+ include an IBM or compatible system, Windows 95/NT 4.0 for scrolling, and an available serial or mouse port. The estimated street price is \$149 including sales tax.

For more information circle **165** on the reader service card or contact BJE Enterprises, 124 Rowe Street, Eastwood 2122.

### New 8GB tape drive from HP

Hewlett-Packard has introduced a tape backup system that expands HP's line of small business solutions. The HP Colorado 8GB (internal and external) tape drive now makes full-system data protection faster, easier and more affordable for smaller networks and desktop PCs. It further strengthens HP's small-business desktop data-protection portfolio, which currently includes the HP Colorado 5GB drive.

The HP Colorado 5GB and 8GB tape drives are one of the industry's highest-capacity and fastest backup products. Based on a high-performance IDE controller, they are two to three times faster than floppy-controller-based tape drives, do not require proprietary add-in cards and feature simplified installation and operation. Both drives also meet high reliability standards, with a minimum 200,000 hours MTBF (mean time between failures) rate.

The estimated street price including sales for the HP Colorado 5GB drive is \$429 (internal version) and \$499 (external version), while the corresponding prices for the 8GB drive are \$589 and \$699. The products include a two-year limited warranty.

For more information circle **166** on the reader service card or call HP Australia's Customer Service Centre on 131 347.

### Motion controllers for DC motors

Colourview Electronics has introduced Motion Controllers for minimotor brushless DC servo motors and DC micromotors. Based on a fast and powerful 16-bit microcomputer system, the controllers guarantee high dynamics, precise positioning and quiet running.

Operation has been kept as simple as possible, with the use of just a few highly efficient functions. Manual balancing or potentiometers are no longer required. Menu-guided program and parameter-editing functions are already integrated, for operation with an ASCII terminal. In place of internal menu management, the clearly structured command set can be integrated into a customer-specific interface — e.g. with Visual Basic, Lab View, Pascal, C++ etc.

Any PC with Windows operating system can be used as an input terminal. Program updates are made directly via the serial interface, without changing the hardware. The controllers are suitable for a wide range of applications including insertion and handling machines, robots, X-Y tables, machine tools, automation systems etc.

For more information circle **167** on the reader service card or contact Colourview Electronics (Qld), 5 Commerce Street, Salisbury 4107. ♦

## SEMICONDUCTOR REPLACEMENT PROBLEMS ?

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Email: colourv@colourview.com.au

(Distributors required)



by **Graham Cattley**

**A**S YOU ARE PROBABLY AWARE, *Electronics Australia* now has its own home page at <http://www.electronic-saustralia.com.au/>. The site we've obtained has started out rather small, but we hope to be able to expand on it in the near future.

So, what does the site have to offer, at this stage? Well, you can see 'What's Hot' in the current issue, have a peek at the contents page, and check out the benefits of becoming a subscriber. But to rate in Webwatch, a site has to have *something* else going for it, and so I'll mention the HUGE file download area, with around 250 files taken directly from our BBS.

We're adding to and updating the site every month, so please drop by and take a look. We're also open to your comments, so please feel free to drop us a line and let us know what you think.



**WESTERN ELECTRIC** sure know their motors — electric ones, that is. Their Australian site <http://www.westernelectric.com.au/> is a good example of how you can run a corporate site without just presenting a catalog on line. Separate pages giving motor FAQs and selection hints are good, but you'll probably be more interested in the slightly less specialised 'How a motor works' page, which goes into things like Fleming's right hand rule, speed/poles/frequency calculations and torque curves.

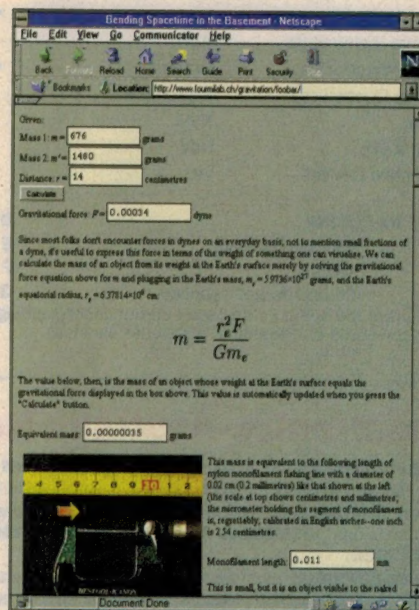
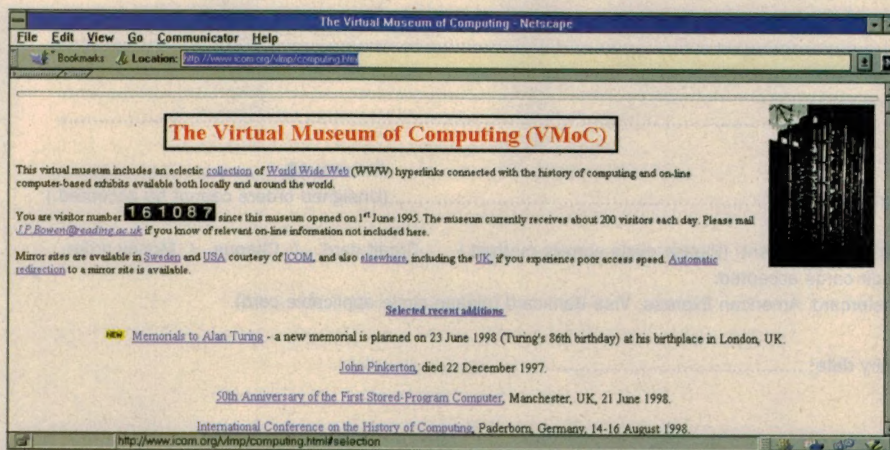
**I KNOW THAT I** mentioned John Walker's Index Librorum Liberorum last month, but I came across another reference to a page listed on his site at <http://www.fourmilab.ch/gravitation/foob/>,

which covers the interesting topic of how to bend space-time in your basement. If this sounds intriguing, go and have a look, and then spend the rest of the week going through the rest of the Fourmilab site — one that I feel rates as the best site of all time.

**TERMINAL ONE** have a couple of sections on electronics and robotics, as well as electric cars and aircraft, on their site at <http://www.pitt.edu/~olgst/>. There's not much on this site, but it makes a good jumping-off point from their lists of related links.

**THE COLLECTION OF** Computer Science Bibliographies at <http://liinwww.ira.uka.de/biblio-graphy/index.html> contains nearly a million references, and over 30,000 pointers to on-line versions of articles. It's the place to start if you are researching anything to do with computers or computing. A bit dry at first, this site can lead you on to a lot of interesting information, and also direct you to a further 2000 other related sites.

**ONE OF THE SITES** listed by the International Council of Museums is the Virtual Museum of Computing at <http://www.icom.org/vlmp/computing.html>. Typical of other ICOM sites, this museum pulls together a huge number of resources on the history of computing, including interviews, corporate histories, computer simulators and a list of virtual exhibits. These are fun, particularly Bob's Computer Museum page which has photos and quite descriptive text on the many, many computers he has collected over the years. Have a poke around, and who knows — you might come across an old friend... ♦



Due to popular request, I've collated a list of all the sites ever covered in Webwatch, and it is available for download from both our web site and our BBS, as **WEBWATCH.WWW** in the Useful Utilities section. You can save the file on your own system, and use it as a handy reference; then download the update every month. And if you know of any sites that you feel deserve a mention in Webwatch, drop me a line at [grahamc@hannan.com.au](mailto:grahamc@hannan.com.au), and I'll be happy to include it in an upcoming column.



# EA Directory of Suppliers

Which of our many advertisers are most likely to be able to sell you that special component, instrument, kit or tool? It's not always easy to decide, because they can't advertise all of their product lines each month. Also, some are wholesalers and don't sell to the public. The table below is published as a special service to EA readers, as a guide to the main products sold by our retail advertisers. For address information see the advertisements in this or other recent issues.

Supplier	State	A	B	C	D	E	F	G
Altronics	WA	.	.	.	.	.	.	.
Dick Smith Electronics	ALL	.	.	.	.	.	.	.
Emona Instruments	NSW	.	.	.	.	.	.	.
Jaycar Electronics	Eastern	.	.	.	.	.	.	.
Oatley Electronics	Eastern	.	.	.	.	.	.	.
Obiat	NSW	.	.	.	.	.	.	.
RCS Radio	NSW	.	.	.	.	.	.	.
Scientific Devices	VIC	.	.	.	.	.	.	.

## KEY TO CODING

A Kits and modules

B Tools

C PC boards and supplies

D

Components

E

IC chips and semiconductors

F

Test and measuring instruments

G

Reference books

Note that the above list is based on our understanding of the products sold by the firms concerned. If there are any errors or omissions, please let us know.

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**\*\*\* FANTASTIC BARGAIN \*\*\***  
**COMPUTER POWER SUPPLY PCB:**  
 New PCB assembly. Dimensions are 45 x 108 x 200mm. Switchable 120/230V AC input. DC outputs are +5V @ 6A, +12V @ 1A, -12V @ 1A, -5V @ 1A. Data Inc. RU approval. Mains input. Be Quick: (Ps6) \$12 ea. or 4 for \$36

### 3 LED LOGIC PROBE KIT.

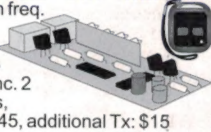
(ref SC May) Ideal for tracing digital logic faults & powered by the circuit under test.

Inc. Only PCB, all on-board components, LEDs, LED bezels & Oatley's special case (approx. 35x24x123): (K119) \$7



### TWO CHANNEL UHF REMOTE CONTROL

On freq. of 304MHz, transmitter assembled, receiver is a kit, inc. 2 12V/12A relays, 1Tx + 1Rx kit: \$45, additional Tx: \$15



### \*\*\* \$2 \*\* YES \*\* \$2 \*\*\*

**1-2 VHF VIDEO MODULATORS WITH EVERY CAMERA YOU BUY OR HAVE BOUGHT IN THE PAST INC. DATA SHEET: \$2 (Rm2)**



### OPTICAL TACHOMETER KIT

Measures RPM of prop. shafts etc. without physical contact. Similar to the kit published in SC. ( May 1988 ), but includes X-tal control calibrator. Use a DMM on 200mV or a 3 1/2 digit panel meter as the display PCB + all on-board components: (K117) \$25.

### MAGNETS: HIGH POWER NEO-DYMIUM RARE EARTH MAGNETS

Very strong You will not be able to separate two of these by pulling them apart directly away from each other. Zinc coated. ---CYLINDRICAL 7mm diameter x 3mm thick: (G37) \$2.50. ---CYLINDRICAL 10mm dia- meter x 3mm thick: (G38) \$5. ---TOROIDAL 50mm outer, 35mm inner, 5mm thick: (G39) \$12. ---ROD 10mm long, 4mm diameter: (G54) \$2.50. ---CYLINDRICAL 3mm diameter x 1.5mm thick: (G58) 2 for \$1

### \*\*SPECIAL\*\*SPECIAL\*\*SPECIAL\*\* FOR \$1 EXTRA WITH EACH ORDER WE WILL SEND A WIRING KIT !!!

Great for cars, radios mobile phones, fog lights etc. 4 colours, 2 gauges of wire, Spade connectors, fuse holders, fuses. 17+ mtrs. of wire. Limited offer!!!! just \$1

### HIGH RESOLUTION MONITOR

Brand new 240V 30cm enclosed computer monitor + video conversion kit. Gives better resolution than TV! Limited good qty. BARGAIN PRICE.



### SOLID STATE 4-6A PELTIER EFFECT COOLER/HEATER

3.3A @ 14V PELTIER: \$27, 6A @ 15V Peltier: \$35, both are approx. 40X40X4mm, can be temperature controlled by reducing supply voltage/current, will even work from a 1.5V battery!! We supply Peltier Effect device, data sheet, diagram & circuit for a small fridge / heater.. Other requirements: Insulated box, 2 large heatsinks, & a small aluminium block. This device is used in the common 15Lr car fridge. Peltier effect Device + (G02) 12V DC Fan: (G11)



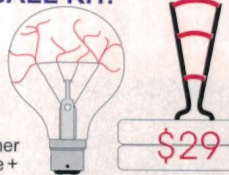
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 Post & Pack typically \$6

**MAJOR SALE / SATURDAY TRADING**  
 We will be open some Saturdays. On these days you can pick-up orders and view advertised and bargain priced limited stock items, mixed orders should be placed prior. \*\*\* MAJOR SALE \*\*\* On 18 / 7 / 98 at two close locations. More info one week before the sale: on our Web Site or E-mail us " JULY SALE " in the subject box. The next sale day is Saturday 15 Aug.

### \*\*\* PLASMA DISPLAY BALL KIT: \*\*\*

A new HIGH POWER HIGH FREQUENCY EHT generator that will give an interesting and Exciting plasma discharge inside a standard Domestic light bulb or It can also be used to make a JACOBS LADDER or LADEN JAR and other EHT applications. Easy to modify primary coil + room for more secondary windings. Can be converted to a HV. DC. Supply with a HV diode. Inc. EHT transformer + PCB + all on-board Components & 1KV. fast Diode + application notes. To reduce the price we include some new recovered parts Requires 12V @ 0.5-2A supply depending on application. Special introductory price \$29.....16KV. Diode \$1.50



### \*\* BARGAIN CORNER ON THE NET \*\*

IF YOU HAVEN'T CHECKED OUR BARGAIN CORNER ON THE NET LATELY THEN YOU MAY HAVE MISSED SOME OF THE CONSTANTLY CHANGING BARGAINS LIKE UPS's FOR JUST \$50 PLUS LOTS MORE. MOST ITEMS ARE IN QUANTITIES TO SMALL TO ADVERTISE HERE

[www.ozemail.com.au/~oatley](http://www.ozemail.com.au/~oatley)

### CASE AND SWIVEL

Small case for cameras, + strong adjustable universal bracket: \$4  
 Bracket only: \$1.50



### STROBE KIT:

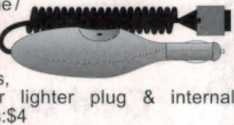
Based on a flash unit removed from a disposable camera. We supply an additional PCB and a few additional components plus instructions on how to convert the flash unit into a low power consumption strobe which is highly visible and operates from a 1.5V battery. Could also be used as a warning light for bicycles that will make you highly visible to motorists. Put several of these strobes in a darkened room for the best effect: (K87) \$7 each or 5 for \$30

### MODEL TRAIN CONTROLLER KIT:

Ref: SC Jul 95. This allows two trains to be run on one loop of track, without hitting each other due to speed differences. When the train breaks an infra red beam it switches off the power to a portion of the track, until the other train catches up and breaks another beam at another location. Circuit uses a relay to switch these two sections of the track. Main PCB: 96 x 66mm, Infra Red Sensing PCB's: 59 x 14mm: (K58) \$28

### MOBILE PHONE HANDS FREE KIT

To suit several different brands of mobile phone. sold for parts only Unfortunately We can't pick the type you will receive. Inc. earphone / Microphone with 2.5mm plug to suit most phones, fused cigar lighter plug & internal components: \$4

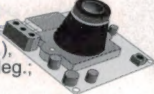


### \*\*\* CCD CAMERA SPECIAL \*\*\*

The best "value for money" CCD camera on the market! 0.1 lux, High IR response & high res. Performs better than many cheaper models.

### WITH YOUR CHOICE

OF 1 OF THESE LENS Pinhole (60deg.), 78 deg., 92 deg.; 120 deg., \$89 or 150 deg: \$99



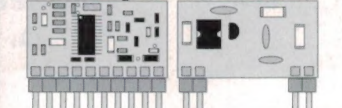
### NEW! 4ch. UHF LEARNING REMOTE

Can be programmed as a spare for your current remote or to replace up to 4 other units and combine into 1: (TX1) \$39



### UHF DATA TRANSMISSION

Stamp sized Xtal locked 433.9MHz superhetrodyne receiver module \$25  
 Small matching transmitter kit: \$12



### AMP-PREAMP & MORE

A professional mostly Surface Mount PCB WITH a TDA1905 5W amplifier IC, and a separate audio pre-amp section. We also provide a pre-wired high quality unidirectional electret microphone that has a wind filter & clip. A small speaker and hook up info. Appears to have been designed for a communications system. Great for many applications including a two way intercom (2 required) that does not require switching! Available at less than the cost of the electret microphone: (AP3) \$10 each or 2 for \$18.

### ULTRA-SONIC MOVEMENT DETECTOR KIT

Uses proven 40Kz X-tal locked osc design. Can be used as a stand alone alarm with adjustable range, on-board timer & logic output or install supplied FET on the output to drive alarms etc. Kit inc. Ultra sonic transmitter & receiver transducers + PCB & all on-board components + output FET. \$16

### UHF A-V TRANSMITTER.

Send video from VCR's or CCD cameras to TVs in your home. Inc. Metal case telescopic antenna & leads: 12V operation, tunable (G01) \$35



### CCD IMAGE SENSOR:

High quality "Thomson" brand, 2/3" CCD Image Sensor (part # TH7863-TBE1) 576 x 384 pixels. Inc data but no circuit suggestions available. Usable response 400 to 1100nm, 30dB S/N at 40 milli-lux, 2/3" optics compatible format: (D10) \$35

### \*\*\* TRANSISTOR SPECIALS \*\*\*

BU-205 HIGH VOLTAGE \$2.50  
 2SD-1554 HIGH VOLTAGE \$5.00

### \*\*\* SPECIAL FREE OFFER \*\*\*

BUY ONE OF OUR CMOS OR CCD CAMERAS & RECEIVE ONE OF OUR LED IR ILLUMINATORS ( see in total darkness ) - ABSOLUTELY FREE PLUS \$20 DISCOUNT ON OUR 4 CH A/V SWITCHER. This has to be the best "value for money" CMOS - CCD camera deal on the market!!!

### LED IR ILLUMINATORS KITS 10

LED: (K103) \$14, 30 LED: (K102) \$30

### \*\*\* SPECIAL BARGAIN \*\*\*

12V/7Ah GEL BATTERY BARGAIN  
 Fresh stock of NEW standard battery \$22

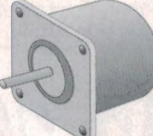
### \*\*\* TWO GREAT SPECIALS \*\*\*

\*\*\*STEPPER MOTOR DRIVER KITS\*\*\*  
**NEW!!! COMPUTER CONTROLLED STEPPER MOTOR KIT** New improved kit that can drive larger motors and has optoisolation between the circuit and the computer. Inc. software and notes: \$40 or \$50 with two used 1.8deg. motors !!!

**(ONE NEW MOTOR OF SIMILAR QUALITY AS THIS ONE COSTS OVER \$100)**

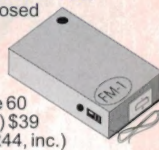
**STEPPER MOTOR DRIVER KIT** Kit inc. a large used 1.8deg. (200 step / rev) motor & uses SAA-1042A IC. **(ONE OF THESE CHIPS WOULD RETAIL FOR ALMOST \$19 )**

Controls inc. ext. clock, on-board clock logic CW or CCW rotation, half or full step, enable/disable, clock speed 1 motor: \$20 or 2 motors: \$30



### MINIATURE FM TRANSMITTER

(33 x 23 x 10mm) enclosed in a small black metal case. Built in switch & microphone. Specs.: 88 to 108- MHz (adj.), with a wire ant. bat. life 60 hrs, Range 50M: (G14) \$39 (Std. watch battery LR44, inc.)



### \*\*\* GET THEM BEFORE THEY GO \*\*\*

**HELIUM - NEON LASER TUBE & SUPPLY KIT:** Helium Neon 633nm red laser heads in a metal tube with a ballast resistor. Removed from less than 5 year old equipment Great for light shows or holography. 2-3mW. Inc. a special high voltage supply. operation at a very dangerous energy level. Tube & supply: (L03) \$60 This KIT requires 12V @ 2A. **WARNING!!! INVOLVES HIGH VOLTAGE & VERY BRIGHT NOT FOR USE BY CHILDREN!! ALL LASERS MUST BE USED UNDER COMPETENT SUPERVISION.**



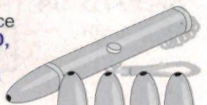
### \*\*\*FINALLY THEY'RE COMING BACK\*\*\*

#### SOLAR PANELS KITS

9" X 12", 12V/2.5W Panels ( US made )+ terminating clips & backing glass. Good but limited supply: \$25 Ea. or 4 for \$80

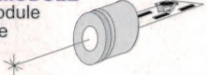
### LASER DIODE POINTER ( Key-chain )

Very bright ( 650 nm ) pointer. supplied with 4 extralens caps that produce symbols: CUPID, I LOVE YOU, LOVE HEARTS & A LADY. \$29



### LASER DIODE MODULE

Same quality module that is used in the above laser pointer: \$24



### POWER MOSFETS:

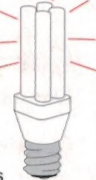
2sk 2175 15A-60V N chn. Has diode clamp ie. not static sensitive. Suitable substitute for devices like BUZ71A or MTP3055E: 10 FOR \$10

### 8 CHANNEL IR REMOTE CONTROL

This kit converts a Magnavox IR remote into an IR remote with a SM5021 encoder IC. We use the case & 8 keys, and replace the PCB. The RX uses an IR RX module on 38KHz. There are 8 outputs. 2 of outputs toggle & 6 momentary outputs. To convert the TTL outputs to drive a relay, use our (K ) Dual Relay Kit. Tx PCB: 89 x 30mm. Rx PCB: 48 x 34mm: \* TX Kit:

### CFL AND BALLAST INVERTER KIT:

Power efficient fluorescent 12V lighting. Unlike cheap commercial fluorescent tube drivers, our kit gets long life from tubes & is very efficient. It simply generates DCV's @ around 250V-350V at up to 40W. Most electronic compact fluorescents (CFL) & electronic ballasts only need a DC voltage to operate. CFL's last 1000's hrs. & are very efficient. Some common suitable brands are 'Nelson', 'Philips' PL series, 'Osram' but 'Wotan'. 'Performer' are not. They available at lighting shops & supermarkets. Our HF electronic ballasts are also suitable. PCB: 124 x 41mm. Kit with Power Mosfets to operate up to 40W CFL's / Electronic Ballast's: (K111) \$25-Extra CFL's \$11



### BRASS SPY HOLES

Quality made spy holes for doors etc. Easy to fit, just drill a single hole. Will fit door / panel thickness from 33 to 52mm.



### POWER MOSFETS:

2sk 2175 15A-60V N chn. Has diode clamp ie. not static sensitive. Suitable substitute for devices like BUZ71A or MTP3055E: 10 FOR \$10



# Where do you GO for the last word in electronics...

## Sound barrier car speaker HR400

These 100 watt, 2-way speakers deliver truly Hi-Fi sound reproduction. With balanced drive dome tweeters, 90dB sensitivity and frequency response of 50-20,000Hz. A 0700



**\$79<sup>95</sup>**



## Sound barrier HR car speakers

### HR500 5 1/4" (125mm)

120W A 0701



**\$89<sup>95</sup>**



### HR650 5 1/4" (165mm)

160W A 0702



**\$99**



### HR690 6" x 9" (150 x 235)

200W A 0703



**\$179**



## Surface mount tweeter

150W A 0705



**\$69<sup>95</sup>**



## Power noise filter

Use this 30 amp noise filter with high powered car audio head units and amplifiers. A 7302

**digitor**

**\$55**



## Car audio accessories

Line out converter A 7303

**\$28**

Power noise filter 10A A 7304

**\$35**

Ground loop isolator A 7305

**digitor**

**\$28**



## Super low loss OFC cable

315/0.12mm speaker cable providing the best performance for demanding audiophile applications. Features PVC insulation.

W 2017

**\$4<sup>50</sup>/m**

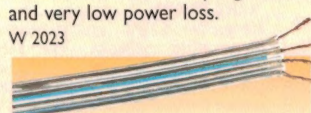


## Dual fig. 8 OFC cable

With PVC insulation, this 63/0.1mm 4-core speaker cable features extremely high conductivity and very low power loss.

W 2023

**\$2<sup>50</sup>/m**



## Heavy-duty DC cable

For installations with a huge DC current need. High quality OFC copper conductors and flexible PVC sheath allow easier installations in tight spaces.

Red W 2306 Black W 2308

**\$6<sup>50</sup>/m**



## Gold power distribution block

Heavy-duty distribution block for feeding DC to a number of devices. Large 4GA inlet and outlet and 4 smaller 8GA outlets.

Size: 68 x 52 x 34mm (LWH). D 6120

**\$9<sup>95</sup>**



## Gold DC power connectors

Fused power distribution box D 6122

**\$18<sup>50</sup>**

Gold in-line fuse holder D 6118

**\$9<sup>95</sup>**

Gold power terminal 8GA cable D 6112

**\$5<sup>95</sup>**

Gold power terminal 4GA cable D 6114

**\$6<sup>95</sup>**



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